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A N  
E S S A Y

On the Waters of  
HARROGATE and THORP-ARCH  
In YORKSHIRE;

Containing some Directions for their Use in Diseases.

TO WHICH ARE PREFIXED,  
Observations on Mineral Waters in general,  
A N D  
The Method of analysing them.

---

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PHYSICIAN to the LEEDS INFIRMARY.

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*Ignotis errare locis ignota videre  
Flumina gaudebat; studio minuentē laborem.—OVID.*

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## P R E F A C E.

**I**N the year 1769 I made some experiments on the sulphureous water at Harrogate which were communicated to the very accurate and ingenious Dr. BLACK, professor of chemistry in the University of Edinburgh, where I was then a student. They were afterwards made the subject of my thesis in 1770. It is to this celebrated professor that I am chiefly indebted for the information which I formerly received on the subject of mineral waters in general; and I could not omit the opportunity of paying this tribute of gratitude and perfect esteem to the man who honoured me early with his friendship, and whose instructive lectures first inspired me with a desire of cultivating philosophical and chemical knowledge.

Since the year 1769, many opportunities have occurred to me of observing the beneficial efficacy of Harrogate waters in a variety of instances ; and also of remarking the evident disadvantages which have attended the use of them in particular cases where they have been unadvisedly taken, either in too large quantities, or under such circumstances of disease as required very different remedies.

A long and intimate acquaintance with a gentleman of the medical profession, who had for many years paid an annual visit to Harrogate on his own account, led me to the knowledge of some facts respecting the use and abuse of these waters. Observation and experience in cases which have fallen under my own immediate direction have furnished me with others. In the year 1783 I repeated all the experiments which I had formerly made on the sulphureous water, and added to them some others which it was thought might illustrate the subject more fully.

It is rather to be regretted that till Dr. Falconer's Essay on Bath Waters appeared, we had no author upon whose chemical accuracy we could fully depend on the subject of mineral waters in general, nor had any proper rules been given by  
which

which we could investigate their contents with precision. And though I have not followed Dr. Falconer's plan, I have received considerable instruction from his labours, and had his views been extended to the mineral waters in this county commonly frequented, the present brief essay had never appeared. But as no experiments have hitherto been published, so far as I know, except those of Dr. Short which are not conclusive, on the water at Thorp-Arch, a village now claiming its share of reputation as a place of fashionable resort; and as Harrogate has long been in high estimation for the medical virtues of its springs, it was thought some account of the principles of both these waters, and of the particular diseases in which they have been found beneficial, might not prove altogether useless; and should it meet with the approbation of the public, the author's intention will be fully answered.

The following essay is designed to give

I. A short account of those bodies which have been found to enter into the composition of mineral waters in general.

II. The method of making experiments to ascertain the contents of such waters.

III. An exemplification of this method by an analysis of Harrogate water.

IV. Some account of the diseases in which Harrogate water has been found useful.

V. Some experiments made on the mineral water of Thorp-Arch ; with observations on its medicinal virtues and uses.

LEEDS, May 27th, 1784.

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## P A R T I.

### OF THE CONTENTS OF MINERAL WATERS IN GENERAL.

PURE elementary water is not only a grateful and wholesome diluent, but, on many occasions, supplies us with the means of correcting, and rendering more bland and salutary, the fluids of the body, while under the influence of disease. We have striking examples of this, in some who have drank, with evident advantage, the Malvern water in Worcestershire, the purest spring yet known in England.\* But when waters are impregnated with mineral substances, such as give a gentle stimulus to the system, or by their chemical properties change the nature of the juices in the first passages, strengthen the powers of digestion, or unload the bowels of their contents, we can apply them with still greater certainty in the cure of many obstinate diseases, to which the human body is singularly liable.

B

That

\* Vide WALL's Medical Tracts, p. 107, & seq.

That great physician Dr. HOFFMAN, who first gave us the outlines of a general plan for investigating the contents of mineral waters, in his examination of those in greatest repute upon the continent, has also added his testimony in support of the peculiar efficacy of mineral waters in general: His words are, “ Non vero ad rescandas viscerum obstructions, impuros humores attemperandos, excretiones per alvum, urinam, et cutim, quinetiam sanguineas suppressas promovendas, et sanguinis circulum per totum corpus aequalem reddendum, ex toto remediorum tam pharmaceuticorum, quam diaeteticorum apparatu, certius, praestantius, et universalius est subsidium, quam quod ex prudenti aquarum mineralium usu recipere, benignè permittit natura.”\*

Before we proceed farther, it will be necessary to ascertain what those bodies are, which are capable of entering in a state either of suspension, or of solution, into mineral waters; to discover them by experiment; and, according to the various impregnations of different springs, to recommend them as remedies in particular diseases: For without a chemical examination of mineral waters, we cannot attain a proper knowledge

\* Vide HOFFMAN. Opera Tom. iii. p. 71.

ledge of their component principles, nor establish their virtues upon a reasonable foundation.

Were we to rely on speculative opinions alone, without having recourse to facts, we might conclude with some writers, that springs of water could only be impregnated with *fossil bodies* : but later observations have contradicted this supposition ; for, though it may, perhaps, be impossible, that vegetable and animal substances should be generated in the bowels of the earth, from whence most springs arise, or be carried thither without suffering some change, or decomposition, by the various bodies they may be liable to meet with in their progress ; yet there is a probability, and experience confirms it, that these substances may, and sometimes do, impregnate mineral waters, though, perhaps, without being conveyed to their origin.

Yet, were it necessary, it would be easy to prove from the authority of a very correct observer,\* that after heavy rains, the waters from the surface are commonly determined to the bottoms of deep mines, as soon as they have had time to sink down through the earth. Hence the opinion of De la Hire, Calcott, and others, who say rain water

B 2

docs

\* PRYCE on Minerals, Mines, &c. p. 17, & seq.

does not sink two feet below the surface, is altogether erroneous, for if it does not enter into the bowels of the earth, what else should occasion so vast an increase of water in mines, at, or soon after, its discharge from the clouds.

Should vegetable or animal matter, therefore, be found on the surface of the earth, in the neighbourhood of springs, it is probable, that after heavy rains, it will find a passage into such springs either just before they break forth, or sometimes near their origin; and by that means impart to them its own qualities. The situation alone, of some springs, may render them liable to this kind of impregnation; since it sometimes happens, that springs first appear in marshy places, where they remain, for a time, exposed to the air, and imbibe the properties of such bodies as they meet with on the surface, but are again carried off under ground, after having received these additions, and break out a second time at a considerable distance. We have an instance of this in the sulphureous water at Harrogate, which first forms a marsh, or bog, on the higher ground, and after sinking deep into the earth, makes its appearance a second time, in four different wells, situated near each other, at the village of Low-HARROGATE.

Without

Without entering farther into argument on this subject, let us appeal to facts. MARGRAAF,\* whose accuracy, no one, I may venture to say, will call in question; and whose experiments appear to have been conducted with great care and attention, informs us, that he obtained a quantity of pure nitre from the waters of Berlin in Germany; and we know, that nitre has never been found, either in Europe, or the East-Indies, except in such earthy or stony bodies, as have received a certain proportion of moisture from animal or vegetable substances in a state of putrefaction: And when it is artificially produced, it is by the concurrence of similar circumstances.

Dr. Leigh, in the natural history of the mineral waters of Lancashire, relates, that out of a gallon of water taken from a spring in that county, he obtained half an ounce of salt, the crystals of which resembled those of nitre; and, when mixed with sulphur, fulminated in the fire; which is a distinguishing mark of true nitre.

Trumphius, in his natural history of the city of Verda, in the 7th vol. of the *Acta Curiosorum*, tells us, that he found two different springs, the waters of which yielded, on evaporation, an inflammable salt.

B 3

From

\* Vide *Opuscules Chymiques* de M. Margraaf, Tom. II. p. 50.

From probability, therefore, as well as from facts, it appears, that vegetable and animal substances, or the productions of these, do sometimes enter into the composition of mineral waters : and this suggests one remark, which, though it will lead me into a short digression, may not prove altogether unworthy of attention.

It appears that in almost every instance where nitre has been found in water, it has been in the wells, or pump-water, of cities, or towns ; and it cannot well be otherwise. Dr. Neumann\* observes, “ that nitrous salt is produced without much assistance from art, in places where putrefaction is going on ; in grounds frequently trodden by cattle, and impregnated with their excrements ; where vegetables rot ; about slaughter houses, lay stalls, and in burying grounds ; on old shady walls, exposed to putrid vapours as those of stables, pigeon-houses, and dunghills.” The great impropriety, therefore, of having large cemeteries in populous cities and towns, is evident ; where, besides many other obvious inconveniencies †, the water is liable to impregnations  
from

\* Vide LEWIS's Edition of Neumann's Chemistry 8vo, vol. i. p. 308.

† For a farther account of the destructive consequences attendant on the interment of dead bodies in great cities, see  
“ Some

from them, especially after heavy rains ; as is clearly the case with several of the springs in London, which Dr. Heberden says, collect many impurities from cellars, burying grounds, &c. ‡

I have known families supplied with water, for culinary purposes too, from pumps placed immediately contiguous to a church-yard, which being generally an elevated piece of ground, chosen purposely for the sake of a dry soil, must render the water in the neighbourhood of such places still more liable to impure mixtures.

It has often struck me very forcibly, that, while many laudable improvements are daily making in respect to ventilation and cleanliness, so little attention should be paid by the police of our country, to the removal of so material a nuisance as that of public burial grounds, from the centre of cities and large towns, to some convenient distance from them. No inconvenience could arise from this change of a long established custom, which would not be greatly outweighed by the public advantage it would occasion.

B 4 Much

“ Some Account of the Life of the late Dr. Fothergill,” prefixed to his works, by my worthy friend and fellow student Dr. Lettsom of London, who is not less distinguished for his humanity and integrity in the line of his profession, than for his literary labours exercised for the public good. p. cx. to p. cxv. including the notes.

‡ See Medical Transact. vol. i. p. 10.

Much more might be said on this subject, were it not foreign to our present design.

It is remarked by Dr. Falconer, \* that we must not always deny the impregnation of waters with substances from a preconceived opinion of their indissolubility in a watery menstruum; as many bodies are capable of so minute a diffusion through the body of a fluid, as to produce the same effects on the constitution, that they would have done, in a state of solution, and by that means bring them under our definition of medicated, or mineral waters.

Having made these general remarks, we shall next proceed to the consideration and division of those substances, which observation and experiment have demonstrated to be present in different mineral springs. They may be divided into the following;

I. *AIR.*

II. *SALINE BODIES,*

III. *EARTHS.*

IV. *SULPHUR.*

V. *BITUMENS.*

VI. *METALLIC SUBSTANCES.*

Of each of these we shall endeavour to give a brief account.

*Of*

\* Essay on Bath Waters, vol. i. p. 8.

## I. Of Fixed Air.

THE elastic fluids which have been extracted from mineral waters, are of three kinds, viz. *inflammable*, *phlogisticated*, and *fixed* air.

These are found to exist sometimes separately, and sometimes united together in the same water; but they differ in their modes of combination; being in some instances so loosely attached, that mere exposure to the atmosphere will allow them to escape; whereas, at other times, M. De Luc has found that long boiling is hardly sufficient to expel all the air which some waters contain.

But the species of air which affords the most frequent impregnation to mineral waters, and imparts to them the most remarkable properties, is, what is commonly called *fixed air*.

Dr. Hales, when he examined the mineral waters of Pyrmont, found, that they abounded with air; and supposed they owed their spirit and briskness to this circumstance; but did not seem to know that this air differed from that of the atmosphere.

Dr.

Dr. Brownrigg \* has remarked, that a more intimate acquaintance with the noxious airs in mines, called *Damps*, might lead to the discovery of that subtile principle in mineral waters known by the name of their spirit; and believed the *Choke Damp* to be a fluid permanently elastic.

We had, however, no very distinct idea of the nature of this aerial matter, especially when mixed with water, till the ingenious H. Cavendish, Esq; gave some account of it in the Philosophical Transactions for the years 1766, and 1767. Experience has taught us, that his veracity and his experiments, are to be relied on. He found that water would absorb a very large quantity of this air, more than equal to its own bulk; that cold water possessed this property in a greater degree than warm; that it received a very sensible brisk taste from it, and put on a sparkling appearance when agitated,

We owe much to this writer for his judicious remarks; but it was left to the unwearied activity of that great Philosopher and accurate Chemist Dr. BLACK, to illustrate more fully the doctrine of fixed air, first in his inaugural dissertation; and afterwards, upon a more general scale, in his public

\* Philos. Transf. vol. lv.

public lectures in the College at Edinburgh; where in 1768, I was a witness, among many others, to his successful method of impregnating water with fixed air, by means of a neat apparatus of his own invention, and of which I then took a drawing.

The useful discoveries he there communicated, have been succeeded by others equally instructive and beneficial to mankind: for it seldom happens, that any improvement in the arts and sciences, though the offspring of genius and uncommon abilities, is introduced to the public at once, in that state of perfection to which it afterwards arrives by an industrious prosecution of experiments.

In the number of those who have thus contributed to our information, Dr. Priestley, for the indefatigable attention he has paid to this subject, and the clear illustration he has given of it, merits the acknowledgments of every individual conversant with philosophy.

The experiments of Lavoisier, and of Cavallo, succeeded those of Dr. Priestley, and have deservedly gained a share of public reputation. Many other ingenious pens have been usefully employed on the same subject.

This

This kind of air differs very materially from atmospherical or common air, both in quality and weight, as it immediately proves fatal to animal life, is much heavier than common air, and while the latter is essential to our existence, and also to the consumption of inflammable bodies by fire, fixed air totally extinguishes flame at its first approach. And since we find that water absorbs this air so copiously, we can readily conceive how mineral springs come to be impregnated with it; as it is found in very large quantities in the bowels of the earth, of which we have many fatal instances in coal-mines; where numbers have lost their lives by entering too precipitately into them, when the evil might have been avoided by first introducing the flame of a candle; for while this continues to burn, no dangerous consequences are to be apprehended, but should it be suddenly extinguished, it would prove dangerous to venture farther.

It is called the *Choke-damp* by the miners, in opposition to the *Fire-damp*, to be mentioned hereafter,

When pure water, which is an insipid, tasteless fluid, is impregnated with a greater or less proportion of this air, it acquires a sparkling appearance,

ance, and a brisk, pungent taste, resembling a slight acid : on which account, such waters as contain fixed air in any remarkable degree, have been erroneously called *Acidulæ* ; under a supposition that a mineral acid was present in their composition ; though this is very rarely the case. Pyrmont water appears to be highly impregnated with fixed air, and to contain a small portion of iron ; which is rendered soluble in water by means of this air.

As fixed air is of a volatile, elastic nature, and liable to be expelled from water by heat, it is absolutely necessary to keep Pyrmont, Seltzer, and other waters containing it, closely corked, and in a cool place, to prevent the bottles from breaking. Agitation and exposure to the atmosphere will also deprive these waters of their air, and reduce them to the state of common water.

## II. Of Saline Bodies.

THE saline substances capable of entering into the composition of mineral waters may be divided into

1. ACIDS;
2. ALKALIES;
3. NEUTRAL SALTS.

1. *Acids.*

(a.) VITRIOLIC ACID. When an acid exists in a mineral water in a *separate state*, it is always of the vitriolic kind; since no other acid has yet been discovered, except when associated with other bodies. But the vitriolic, which from its frequent occurrence has been called the *universal acid*, and has been supposed by some, though perhaps erroneously, to form the basis of all the others, both mineral and vegetable, is copiously diffused through the bowels of the earth, and constitutes part of many fossil bodies; some of which are liable to such changes and decompositions, as cause this acid, or at least a part of it, to be separated from the other principles with which it was combined. Thus in the spontaneous solution of pyrites and aluminous slates, there

is found a larger proportion of acid than is necessary to produce vitriol or alum; it therefore sometimes happens, that water which has passed through beds of pyrites, contains a kind of vitriol, or alum, which has some redundant acid in it.

Yet the vitriolic acid is very seldom found in a *separate state* in mineral waters; because, it could not remain long mixed with water, nor could it be conveyed along with this fluid through the many intricate recesses of the earth which it pervades, without forming a combination with some heterogeneous matter that would probably come into contact with it in its progress; such as earthy, saline, or metallic substances. But united with some of these it is not an uncommon impregnation.

When the vitriolic acid is found in water, it is generally in a *fixed state*; though some have asserted that it is also sometimes present in a *volatile form*: but the latter will probably be found, upon strict examination, to be, for the most part, *fixed air*, and not the volatile vitriolic acid in a separate state; since fixed air is capable of producing the same effects on the infusions of blue vegetables.

(b.) NITROUS ACID.

(c.) MURIATIC

(c.) MURIATIC ACID. These acids have never been found to exist in mineral waters in a separate state.

(d.) VEGETABLE ACID. It is improbable that this acid, either separately or combined, should ever enter into the composition of mineral waters.

## 2. *Alkalies.*

(a.) FOSSIL ALKALI. A native mineral alkali is frequently met with on the surface of the earth, particularly in the eastern countries; sometimes tolerably pure, but more commonly mixed with other substances, affording a variety of colours. It is also found plentifully diffused through the bowels of the earth in many parts of the world,\* and though not a common impregnation of mineral springs, has sometimes been found in them.

The ancients frequently mention a salt under the term nitrum or natron, expressive of real nitre, but which appears to have been no other than the fossil alkali.§ Dr. Rutty has fallen into the

\* A true fossil alkaline salt has been found in the inland parts of Tripoli in Barbary; it is not certainly known how it is disposed in the bowels of the earth; but it seems to run in thin veins of about half an inch, or a little more, thick, in a bed of sea salt; for all of it that has hitherto been imported into this country is covered with sea salt on each side.

Phil. Transf. vol. lxi.

§ PHILOS. TRANS. vol. lxi.

the same error in his analysis of mineral waters; in which he has given a separate chapter on *nitrous waters*; a title which is certainly very improper; for what he means by the nitre of the ancients is the mineral alkali we are speaking of; and his *calcareous nitre*, a neutral composed of the vitriolic acid and an earth. The fossil alkali having been generally found joined to a large portion of earthy matter, from which it is easily purified by solution and evaporation, may have given rise to the supposition of its being calcareous nitre, or the nitrous acid combined with calcareous earth; which, though a possible combination, is but rarely met with in mineral waters.

The fossil alkali differs considerably from all the vegetable alkalies we are yet acquainted with. On evaporating solutions of it with a very gentle heat, the salt concretes into crystalline masses, which are not subject to deliquation on exposure to the atmosphere; a circumstance which distinguishes it from the vegetable alkali. It differs also from common alkalies in its combination with the mineral acids: with the vitriolic it does not form vitriolated tartar, but Glauber's salts: with the nitrous not common nitre, but a nitre the crystals of which are parallelipipeds; and hence it has been called quadrangular, or cubic nitre: with the marine, a perfect sea salt.

C

(b.) VEGETABLE

(*b.*) **VEGETABLE ALKALI.** It is difficult to determine from what may be supposed possible or probable, whether a vegetable alkaline salt can ever enter into the composition of mineral waters; as it is generally the production of art; yet since some writers of indisputable accuracy, and among the rest Margraaf,\* have found a vegetable alkali in the waters of particular springs, we ought at least to suspend our judgment on this head: when they contain it, it is probable, that it has been washed from the surface into them, just as they break forth. Yet it must be acknowledged, we are very little acquainted with the internal structure of the earth,§ and how far it may be influenced by subterraneous fires or the phænomena of earthquakes, which frequently happen at a considerable distance from volcanos. † It is not  
very

\* Vide *Opuscules Chymiques* de M. MARGRAAF.

§ A gnat essaying the feeble efforts of its slender proboscis against the hide of an elephant, and attempting thereby to investigate the internal formation of the body of that huge animal, is no unapt representation of man attempting to explore the internal structure of the earth, by digging little holes upon its surface.

WATSON'S ESSAYS, vol. i. p. 184.

† The most remarkable changes which have taken place in the form and constitution of the earth, since the deluge, have probably been produced by subterraneous fires, for it is to their agency that philosophers ascribe volcanos and earthquakes, those tremendous instruments of nature, by which she converts plains into mountains, the ocean into islands, and dry land into stagnant pools. *Idem.*

very uncommon to meet with branches of trees buried very deep in the earth in a state resembling charcoal; and when experiments have been made on these fibrous substances by burning them in the fire, they have appeared to possess all the sensible qualities of wood, and have left a white ash behind them.\*

Allowing this to be true, the heat which was requisite to the formation of these appearances in a state of nature, would have reduced smaller plants to ashes, from which a fixed alkali might have been elixated, and have afforded an impregnation to a running stream:† We may perhaps, therefore, conclude, that the fixed vegetable alkali, though for the most part artificially produced by the assistance of fire, may yet be a possible impregnation of medicated waters; but we believe it to be a very rare ingredient.

C. 2

(c) VOLATILE

\* See, also, an account of the fossil-wood brought from Iceland, in Dr. VON TROIL's letters, page 43, and 355.

† Amber is frequently found in Prussia at the depth of eight or ten feet beneath the surface of the earth, but at no very great distance from the sea: The superincumbent strata are sand, clay, *fossil-wood*, pyrites, sand again, in which the amber is found. This distribution of the strata has rendered it probable that amber was derived partly from an oil arising from the decomposition of vegetables, by subterraneous fires, and partly from a mineral acid.

WATSON'S CHEM. ESSAYS, vol. 3. p. 13 and 14.

(c.) VOLATILE ALKALI. It is very doubtful whether this salt ever exists in mineral waters; for though we have found that substances of vegetable and animal origin do sometimes impregnate springs, yet the volatile alkali, generated from the putrefaction of these bodies, is generally dissipated during the process; but were it to be carried down by the rains into springs of water, it could not remain long exposed to the air, after the water had reached the surface, before it evaporated, and hence could not easily be made the subject of experiment.

### 3. *Neutral Salts.*

(a.) GLAUBER'S SALT. As this is composed of the vitriolic acid and the fossil alkali, both of which are the natural productions of the mineral kingdom, and not unfrequently met with in a separate state, and as their attraction to each other is very powerful, we can easily imagine they may sometimes be found in a state of combination in medicinal springs; yet we have very few, if any, clear evidences of this having ever happened. I am not acquainted with any author, who has satisfactorily proved its existence in them, though it is frequently mentioned as a common ingredient; and the mistake has arisen from its resemblance to Epsom salt in the form of its crystals; but

but from this it differs very materially in the nature of its basis, which is a true fossil alkali; whereas that of Epsom salt is a peculiar kind of absorbent earth. We shall, therefore, consider it as a possible, though not a common, impregnation.

(*b.*) EPSOM SALT. This salt has been found in considerable proportions in the purging mineral waters of Epsom in Surrey; from whence it still preserves the name of Epsom salt; though it may be procured in much larger quantities from the bitter liquor which remains after the crystallization of common salt.

Epsom, or, as it is called in the shops, the bitter cathartic salt, is composed of the vitriolic acid and the earth of magnesia: and as the vitriolic acid has a more powerful attraction to a fixed alkali, than to any of the absorbent earths, it furnishes us with an easy test by which we may distinguish Epsom from Glauber's salt, when they are in a state of solution. If we add a few drops of the ley of tartar to a solution of Glauber's salt in distilled water, no change is observable; but when we add these to a solution of Epsom salt, a precipitation of the earth of magnesia immediately takes place, occasioned by the association of the

alkali with the vitriolic acid, which dislodges the magnesia: and in this manner magnesia alba is commonly prepared; but it requires frequent ablutions till the water which comes off no longer retains that bitter taste peculiar to the salt.

The magnesia in the above process will ferment strongly with acids. But if the *caustic alkali* were to be employed in the precipitation, the magnesia would, by that means, be deprived of its fixed air, and would resemble the calcined sort in every particular: The reason is, that fixed air having a stronger attraction to a fixed alkali than to the earth of magnesia, it forsakes the latter to unite with the former, which had been before deprived of its air by quick-lime. This experiment I have made, and have found it to answer my expectations. It is introduced here as a hint to those who are desirous of depriving magnesia of its fixed air, without the process of calcination.

It is only necessary farther to remark on the subject of Epsom salt, that it is not confined to the springs of Epsom, but has been found in many others, both in England and on the Continent; so that we may safely enumerate it among the more frequent impregnations of mineral waters.

(c.) NITRE.

(c.) NITRE. That nitre sometimes enters into the composition of mineral waters we have before attempted to prove, from the unquestionable evidence of M. Margraaf, and others. We have also remarked that this salt has been supposed to form a more frequent impregnation, than has been found true in reality: and we are far from thinking, that the nitre discovered in the waters at Berlin ought to be considered as a fossil production: we rather imagine that it was first generated on the surface of the earth, and from thence was washed down by the rains into the waters in which it was found collected.

That this is the most probable opinion we are led to believe from what Margraaf farther relates, viz. that a small portion of the fixed vegetable alkali was found to accompany the nitre, which is seldom, if ever, a natural production of the interior parts of the earth.

(d.) COMMON SALT. Of all the neutral salts with which waters are liable to be impregnated, sea salt is the most frequent; as there is hardly an example of a spring totally free from it. It is composed of the muriatic acid and the fossil alkali; and is found in great abundance in many parts of the earth, as well as in the ocean: yet

there is reason to believe that the muriatic acid has never been met with in a *separate state*, either in the earth, or in the sea. This may, perhaps, be satisfactorily accounted for when we consider, that those fossil bodies to which the muriatic acid has hitherto been found united, are not, like the vitriolic pyrites and aluminous earths, subject to deliquation, or spontaneous solution, so as to allow of a separation of the acid; nor to decomposition by the admixture of other substances: for though the acids of vitriol and of nitre expel the acid of sea salt from its basis, especially when assisted by heat; yet the vitriolic acid is never found in the bowels of the earth in such quantity as to produce, in this case, any effect; and the nitrous acid is not a fossil production. Hence the marine acid is always found, when native, in a compound state, united to the mineral alkali, and generally to some other extraneous body of the earthy or saline kind, from which the marine salt is purified when prepared for use.

When common salt is obtained from sea water, it is called *Sea Salt*; when from springs, *Sal Fontanum*; and as there are mines, in almost every country, containing large masses of this salt, it has received the name of *Rock Salt*; some of these pieces are remarkably transparent, and the salt  
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has thence been called *Sal Gemmæ*. There are some of these salt mines in England, particularly at Northwich, where the strata lie very deep, and so immensely thick, that the miners have never yet been able to reach the bottom of them. The salt mines near Cracow in Poland, though they have been wrought above five hundred years, are inferior to the rock-salt-mines of Northwich in respect to the quantity which is annually raised.\* These salts, though they have received different names, and have been obtained from different sources, are all of the same nature when equally pure.

Although cold water is capable of dissolving nearly the same quantity of common salt, as water when heated; yet the ocean contains less salt towards the poles, in the colder climates, and a larger proportion under the equator, where the sun's rays have a more powerful influence; and this may be accounted for from the greater evaporation of the aqueous particles that must necessarily be produced by a vertical sun, than in latitudes liable to continued frost.

There are springs in England saturated with common salt; and several in Germany which are  
nearly

\* WATSON'S CHEM. ESSAYS, vol. ii. p. 40.

nearly so: and since the distribution of this salt is so general over the whole earth; and is of easy solubility in a watery menstruum, we are at no loss to explain, how so many different springs are liable to be impregnated with it, in such an endless variety of proportions.

(*e.*) SAL AMMONIAC. As an accidental ingredient in mineral springs, sal ammoniac ought, perhaps, to have a place here among the neutral salts; but it does not appear that it has ever been met with in any waters except such as spring in the neighbourhood of volcanos. The sal ammoniac of the ancients is now commonly supposed to have been a species of sal gem; which is found native of a variety of colours, occasioned by slight admixtures of different metallic bodies. Yet some have asserted that the true sal ammoniac has been met with adhering to the fissures of rocks, and other cavities, where it had been formed by the foot of volcanos, which had been exposed to such a degree of heat as to sublime the sal ammoniac from the other particles which the foot contained. From hence we see the possibility, that this salt may sometimes be washed by the rains into such springs of water as are found to issue from the earth, in countries liable to volcanic eruptions. But even here we may be deceived

ceived, unless we be particularly cautious; for Dr. Neumann, who examined the saline substances thrown out by volcanos, and which have commonly been said to be sal ammoniac, found, that they frequently contained little or nothing of an ammoniacal nature. He adds, that these saline substances were of various colours, red, green, yellow, and others; that in some sorts, the volatile alkali was really found, but in small proportions only; and that the greater number of them contained none; some participated of the vitriolic acid, and some of the marine; some held an actual sulphur, and some had a cupreous, or ferruginous impregnation. From these considerations, we may draw this conclusion, that the true sal ammoniac, composed of the muriatic acid and the volatile alkali, can very seldom occur in mineral waters, and never at any great distance from volcanos.

III. *Of Earths.*

**O**F the earthy bodies which have been found to exist in different springs, the following are the principal, viz.

- (a.) SIMPLE EARTH.
- (b.) CALCAREOUS EARTH,
- (c.) SELENITES.
- (d.) ALUMINOUS EARTH,
- (e.) MAGNESIA.

(a.) SIMPLE EARTH. There are no springs so pure as not to afford, on evaporation, more or less of earth; but when they contain it in any remarkable quantity, it is always of the calcareous kind; for simple earth seems capable of suspension only, not of dissolution in a watery menstruum.

(b.) CALCAREOUS EARTH. This earth seems not only to be suspended, but also in some measure to be dissolved in water, and frequently without the intervention of any other body, as will appear by the following experiment. If a piece of common chalk be infused in distilled water,

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ter, it will be found, on examination, that the water has actually dissolved a portion of it : for though the water still appears colourless, if we add a few drops of a *saturated* solution of lead in the nitrous acid, the mixture will immediately become turbid, occasioned by the precipitation of the lead.

Some waters naturally contain calcareous earth in such proportions as to acquire the name of *petrefying springs*, in which if mosses, or other vegetable productions be deposited, strong incrustations are formed upon the surfaces of them ; and if the vegetable bodies are of a porous texture, and the water has free access to their internal substance, the whole seems to be converted into a solid heavy mass, resembling the original appearance of the vegetable.

The earthy matter, which waters of this class contain, frequently separates without any assistance from art, if a part of the fluid be allowed to exhale in the open air ; from whence we can account for the formation of those numerous stalactites, or pointed drop-stones, which are often met with in the caverns of the earth. Yet in all petrefying springs, even those which possess this property in a remarkable degree, the quantity of  
calcareous

calcareous earth they contain, is very small; and for this reason petrefactions are formed by slow degrees.

It is by the gradual dropping of springs of this kind, that large columnar masses are formed in the celebrated cave at the Peak in Derbyshire.

Calcareous spar is of this nature, and is easily distinguished by its effervescence and solution in the nitrous and marine acids, and by a selenitical precipitation from solutions of it in the above acids, when the vitriolic is added.

This spar is neither so hard, nor so heavy as the selenitical one which will be presently mentioned, but like that, it crystallizes into a great variety of forms.

Some waters contain calcareous earth in such a state, as to make them resemble *lime-water*; from which it would appear, that this earth had been actually subjected to a degree of heat sufficient to convert it into *quick-lime*. The most remarkable instance of this sort has been discovered in the examination of the Caroline waters, at the Caroline Baths in Germany, which resemble in taste, and in reality possess, all the other qualities  
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of lime-water; and lead us to suspect that they may possibly contain a quantity of real lime: though it may be difficult to account for this phænomenon in a satisfactory manner; yet it is perhaps probable, that strata of lime stone may approach so near to subterraneous fires, as to undergo the necessary changes observable in the production of quick-lime: but this can happen but very seldom, and only in particular situations; because the pressure of the earth, and the want of a due supply of atmospherical air, must, in general, prove unfavourable to fire within the bowels of the earth. Yet how are we, upon any other supposition, reasonably to account for those copious streams of water, which issue from the earth in a heated state; and which have continued to flow, with little or no variation, from the remotest periods of history? Water passing through beds of pyrites cannot solve the difficulty; for pyrites once heated by water is decomposed, and the heat which it occasioned soon after ceases: besides it is improbable there should be such a regular supply of fresh pyrites as to support an equal temperature of heat in waters of this class.\* We may add, that waters heated by this means would receive sensible impregnations, which many of them do not.

In

\* Treatise on Buxton Waters by A. Hunter, M.D.

In the island of St. Miguel, one of the principal, and most fertile of the Azores, there are a number of hot fountains in different parts of the valley; and on a small eminence, by the side of the river, is a basin about thirty feet in diameter, where the water continually boils with prodigious fury. In the middle of the river are several places where the water springs up so hot, that a person cannot dip his fingers into it without being scalded.† There are also springs in Iceland, the heat of which is said to be equal to that of boiling water; one of them, in particular, raised the thermometer to 213 degrees.‡

Would it not be absurd to imagine that these effects were produced by simple mixture; or by the solution of vitriolic pyrites?

We must, therefore, have recourse to subterranean fires to explain these phænomena: But when these fires were first kindled; by what sort of fuel they are still maintained; at what depths below the surface of the earth they are placed; whether they have a mutual communication; what are their dimensions; and how long they may continue,

† PHILOSOPHICAL TRANS. vol. lxxviii. p. 605.

‡ VON TROIL'S Letters on Iceland, vol. i. p. 183.

continue, are questions which do not admit an easy decision. §

(c.) SELENITES. Calcareous earth is also suspended in water by the vitriolic acid, which has a strong attraction to this earth, and forms with it an insipid, selenitical concrete, or gypsum. This always possesses the property of rendering water hard, and unfit for œconomical uses; but in many parts of the world produces, nearly in the same manner as those waters do, in which calcareous earth is suspended without the vitriolic acid, a great variety of curious native stalactites, or, as they are called, petrefactions. Some of these are of uncommon magnitude, and continue to receive daily additions from the water that drops gradually upon them, till their own weight, at length, dislodges them from the rocks to which they once adhered.

This selenitical compound frequently fills up the fissures in mountains, called veins, where the ores of metals are met with in greater plenty; when friable and soft, it obtains the name of *Spar*, has a flaky structure, breaks into a sort of rhomboidal form, and is remarkable for its extraordinary weight, in which it exceeds all other earthy substances.

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Pieces

Pieces of this kind of spar, which are harder and more transparent than the rest, are often converted, by the hand of the artist, into pyramidal columns and vases of singular beauty, which, of late years, have been in great esteem for supplying the drawing-room with some of its most elegant ornaments.

When calcareous earth is united to the muriatic acid, it forms *fixed ammoniac* ; and some have asserted, that this compound has sometimes been found in mineral waters ; while others have denied the possibility of such an impregnation. Future discoveries may, perhaps, unfold the truth. Were I to offer a conjecture, it should be, that though the marine acid is never met with in a separate state, yet its union with the fossil alkali, in conjunction with earthy substances, is so frequent, that it is probable it may be sometimes found united to an earth alone, without an alkali ; and may thereby form the combination in question.

We are also told, that this earth is sometimes suspended in water by means of the nitrous acid, producing *calcareous nitre*.

(*d.*) ALUMINOUS EARTH. Alum affords another impregnation of the compound kind, in  
which

which the vitriolic acid is united to a sort of argillaceous earth; yet forms not a perfect alum, but a mixture in which the acid predominates; and which will not afford crystals unless an alkaline salt be added. Hence it appears, that there are no experiments to prove the existence of perfect alum in mineral waters; a species of it only has hitherto been discovered, in which the vitriolic acid so far prevails as not to allow of the formation of those crystalline appearances peculiar to alum.

(*e.*) **MAGNESIA.** The earth of magnesia is also found in association with the vitriolic acid, which together compose Epsom salt; a frequent ingredient in mineral waters; especially those of the purging kind. For a farther account of which see the article Epsom Salt, at page 21.

## IV. Of Sulphur.

**S**ULPHUR is a substance plentifully diffused throughout the mineral kingdom; there are few ores of metals which do not contain more or less of it; the exceptions are those of tin, bismuth, and cobalt: but it is found united to almost all the rest; particularly to the ferruginous ore call'd *Pyrites*, from which considerable quantities of sulphur are extracted in Sweden and Saxony, where this ore is plentiful, and where the principal sulphur-works are established.

Sulphur has also been found in its native state, in bright yellow transparent masses, though more commonly in opaque ones of a greenish colour. The volcanos of Italy furnish it very copiously, and it has also been met with in those of Iceland\*. There is reason to believe it is produced in these places, by the pyrites that contains it, which being acted upon by a natural fire, the sulphur rises in steam, which is at last condensed on the surface, and in this form produces what is called *Sulphur vivum*.

Sulphur

\* VON TROIL's Letters on Iceland, p. 237.

Sulphur is composed of the vitriolic acid, and phlogiston; but the latter is in so very small a proportion, that in sixteen ounces of sulphur, there are upwards of fifteen ounces and six drachms of pure vitriolic acid. Hence it appears that a pound of sulphur affords scarcely two drachms of inflammable matter.\*

From the nature of this compound we may justly conclude, that it is not, of itself, soluble in water, unless it be first united to an alkaline salt, or calcareous earth, which it always is, when suspended in water in any considerable quantity; though a small portion of it may, as Dr. Nooth informs us, be rendered soluble by means of fixed air.

Those waters, however, which distinguish themselves by the smell of hepar sulphuris, do not always contain that mixture, but in general so little of actual sulphur, that it has been doubted whether they contain any; since this smell may be produced without the presence of sulphur in substance. The waters of Aix-la-Chapelle are said to afford true sulphur on the upper parts of the conduits through which the waters pass; but it does not appear that any sulphur is *deposited* in

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them:

\* NEUMANN'S CHEMISTRY, article Sulphur.

them : for a writer on this subject has remarked \*, that these waters do not contain sulphur actually dissolved in them ; but are impregnated with a phlogiston and an acid, which being in a volatile state, are sublimed, meet on the surface of the conduits, and there unite into perfect sulphur which did not naturally exist in the water.

There is, therefore, another matter of the *volatile* kind which waters called sulphureous commonly contain ; viz. a subtile vapour, which it is impossible to obtain in a solid form, but which produces the same effects on lead, &c. as the fumes arising from sulphur ; and imparts to these waters, when present in large quantities, the smell of hepar sulphuris, putrid eggs, or the scourings of a gun. †

The addition of an acid, to a solution of sulphur in water by means of a fixed alkali, or calcareous

\* Monro on Mineral Waters.

† There is a remarkably strong sulphureous water at Castle-Loed in the county of Ross, in Scotland ; but though Dr. D. Monro took uncommon pains to obtain sulphur from it in a solid form, the quantity was so small as to give him reason to conclude, that the water contained only a very small portion of genuine sulphur ; but that it was highly impregnated with a volatile sulphureous vapour, which soon evaporates when exposed to the open air, and flies off immediately when exposed to heat.

PHIL. TRANS. vol. lxii.

reous earth, causes a fetid vapour to arise, which resembles the subtile sulphureous vapour contained in natural sulphureous waters; and, like that, discolours bright metallic bodies, even at a considerable distance.

It is observed by Neumann, that fixed alkaline salts precipitate sulphur from solutions of it made with quick-lime; and that the fetid smell, so strong in all precipitations of sulphur by acids, is not here perceivable. May we not hence be led to conclude, that during the precipitation of the sulphur from the solution made with an alkaline salt, or calcareous earth, by the vitriolic acid, a part of the acid is detached in a volatile form, and rises into vapour, carrying along with it a small portion of the inflammable principle? And will a natural process of this nature, account for the production of that sulphureous vapour which occurs so frequently in mineral waters? Or, must we have recourse to a combination of the volatile vitriolic acid with a very subtile bitumen? It is indisputably evident, that this vapour is composed of the phlogistic principle joined to some other substance, of which we are ignorant, but which may possibly be the volatile vitriolic acid. Dr. Watson found that the vitriolic acid, when assisted by heat, was capable of dissolving

the common Derbyshire lead-ore, and that a great quantity of air was extricated during the process: he caused this air, as it was discharged from the ore, to pass through a high bended tube, into a bottle full of pump-water; the water in a very little time acquired the fetid smell of Harrogate Water\*.

It is possible that these waters may receive their sulphureous impregnation in the following manner. Let us suppose that a mineral water originally contains hepar sulphuris in its proper form, and that in its progress towards the spring it meets with the vitriolic pyrites, or aluminous slates, containing a superabundant quantity of the vitriolic acid: in that case, the hepar sulphuris will be decomposed, the sulphur precipitated, and a fetid vapour produced. This would also explain to us the reason why sulphureous waters seldom, or never contain sulphur in substance; because it must be precipitated when in contact with the vitriolic acid. I offer this opinion with diffidence, and hazard it only because we have hitherto had no attempts made, as far as I know, to account for the generation of this principle in natural springs; and that the attention of others, better qualified than myself, may be turned towards its farther investigation.

V. *Of*

\* WATSON'S ESSAYS, vol. iii. p. 197 & seq.

V. *Of Bitumens.*

**B**ITUMINOUS bodies are found, in their native state, in various parts of the world, sometimes issuing from the crevices of rocks; at other times, in the bowels of the earth, or on the surface of springs. They are all very inflammable, but differ from each other in respect to consistence; some being in a fluid, others in a solid form.

To the class of bitumens we may, perhaps, refer that extraordinary vapour which is met with in particular mines. It is of a very subtile nature, and is called by the miners the *Fire-Damp*; which is totally different from that noxious vapour before mentioned under the name of *Choke-Damp*; this consists of mephitic air, and is particularly discriminated by its fatal effects on animal life, and the property it possesses of extinguishing flame. But the fire-damp, which we are now considering, does not, in the mixed state in which it is commonly found, render the air unfit for respiration;\* it is, however, liable to take  
fire

\* One of the greatest foughs, or subterraneous passages which has, perhaps, ever been formed in Great Britain, is that which  
is

fire on the approach of flame, which is its most dangerous quality : this effect is as instantaneous as the explosion of gun-powder, and the consequences are equally dreadful.

At the time when I wrote this, June 13th, 1783, a lamentable example of the fatal effects of the fire-damp happened in this neighbourhood, viz. at the colliery at Middleton near LEEDS, in which nine persons lost their lives, by a sudden explosion of this inflammable air. The fact was as follows; the workmen, in one of the lower mines, being incommoded with water, made an opening for it to pass into some old works, into which the air rushed, and issuing out again at an aperture which communicated with an upper mine at a distance, it carried along with it a large body of inflammable vapour, which had been confined for want of a free circulation of air from the shaft; and here coming into contact with the flame of some candles, by the light of which several men were at work in the upper mine, it instantly exploded with such violence as to kill five  
or

is called Hell-Car-Sough, in Derbyshire; this sough is driven through a stratum of *shale*, and the workmen are much troubled with inflammable air, from which they secure themselves by keeping great fans constantly in motion; for the inflammable air being drawn down from thence and mixed with common air by the motion of the fans, it is circulated in the sough without danger." WATSON'S ESSAYS, vol. iii. p. 8.

or six of the miners upon the spot. The workmen who had made the opening in the lower mine, and had been innocently the cause of this calamity, did not then suffer; but hearing the explosion, and fearing they might be suffocated if they kept their situation, consulted about the best means to be taken to save their own lives, and, at last, determined to make their way to the shaft. In doing this, they had to walk through that part of the mine where the men had been killed, and where the sulphureous vapour still remained so strong, that in attempting to pass through it, three or four of them dropped down dead, and only a very few escaped to tell the dreadful narrative.

But though this inflammable vapour is thus liable to be ignited when the flame of a candle is applied to it; yet it has been supposed, that a spark produced by the collision of flint and steel, would not produce any such effect; and in order to gain the advantages of light, without hazard, in coal-mines, engines have been contrived, consisting of a wheel made to turn constantly round, and to strike against flints properly placed to receive the repeated percussions.

These engines are used in some of the collieries in the neighbourhood of Newcastle; and have, I believe

believe, hitherto answered the intention without danger. If this has been found true by repeated trials, we have great reason to lament that it has not been generally adopted. Humanity calls upon us to employ every measure by which the lives of our fellow creatures may be preserved. But the fact should be well ascertained whether a spark be innocent or otherwise, before such engines as we have mentioned be used; because it has been said, that a spark suddenly thrown off from steel is not always harmless. Cavallo \* remarks, “that it is a common practice among the miners to try the hardness of stones by striking them against a steel, and observing if they produce any sparks of fire; this practice should not be permitted near the fire-damp, it having been lately observed, that even a spark of that sort is sometimes sufficient to inflame that elastic fluid.”

But as this inflammable vapour is generally confined to the upper part of the mine, unless when the air is agitated, it is possible, that an engine of the kind above described, may be safely employed at the bottom, where it will be most wanted.

Inflammable air appears to be the cause of remarkable phænomena in particular springs, of  
which

\* CAVALLO ON AIR, p. 242, in a note.

which there are some in Italy: they are in a state of agitation continually, as if boiling with violence, yet the water feels cold to the touch; but if flame be applied to its surface, the vapour which arises from it takes fire, and assumes a blue colour. Wells of this kind have also been met with near Wigan, at Brosely, and other places in England.

The natural effects produced, in some of the larger volcanos, by this bituminous elastic fluid, are sometimes so terrible, as to give occasion to the latin poet to draw the following lively description of the horrors of Mount *Ætna*, during a volcanic eruption;

————— *Horrificis juxta tonat Ætna ruinis :*  
*Interdumque atram prorumpit ad aethera nubem,*  
*Turbine fumantem piceo, et candente favillâ ;*  
*Attollitque globos flammarum, et sidera lambit :*  
*Interdum scopulos, avulsaque viscera montis*  
*Erigit eructans, liquefactaque saxa sub auras*  
*Cum gemitu glomerat ; fundoque exæstuat imo.\**

Next

\* The port capacious and secure from wind,  
 Is to the foot of thundering *Ætna* join'd:  
 By turns a pitchy cloud she rolls on high,  
 By turns hot embers from her entrails fly,  
 And flakes of mounting flames that lick the sky.  
 Oft from her bowels massy rocks are thrown,  
 And shiver'd by the force, come piecemeal down.  
 Oft liquid lakes of burning sulphur flow,  
 Fed from the fiery springs that boil below.

DRYDEN.

Next in degree of subtilty we may mention a species of bitumen called NAPHTHA, which, in its natural state, is as fluid as spirit of wine, and considerably lighter, so that it swims on the surface of the latter.

Naphtha is extremely volatile, colourless, and of a strong smell; and so highly inflammable, that it has been thought, by some, to have been formerly made use of in the composition of the supposed inextinguishable Greek fire.†

It burns with smoke, as all oils do; and KÆMPFER observes, that it is frequently gathered from the surface of particular springs in Persia, and in the East-Indies, where it is employed for making varnishes, as well as for lamps.

Other kinds of bitumen, inferior to naphtha in point of subtilty, are called PETROLEA, from their being met with oozing through the crevices of rocks; though these, like the former, are sometimes found swimming on the surface of waters; and differ little from naphtha but in consistence and colour.

There are some other fossil substances, of the oily inflammable kind, still greatly inferior to those

† See NEUMANN'S CHEMISTRY, article Naphtha.

those we have mentioned, in degree of tenuity, having the thick viscid consistence of the vegetable balsams ; such are Barbadoes tar, and Jew's pitch.

But although these bituminous bodies are often found on the surface of fountain water, yet they are incapable of solution in it, except by the intervention of an alkaline salt, or calcareous earth; which by uniting with them produce a saponaceous mixture, and may render them soluble in aqueous fluids : but we are not warranted by experience to say, that they afford, in this form, a common impregnation. When, however, naphtha, and petroleum are found in their unmixed state, floating on the surface of water, they so far impregnate it, that it will permanently retain a strong bituminous taste and smell, though great pains be taken to separate them from the water.

VI. *Of Metallic Substances.*

FROM among the metallic substances the three following may be selected, as none of the rest have ever been supposed to enter into the composition of mineral waters.

(a.) IRON :

(b.) COPPER :

(c.) ZINC.

(a.) IRON. This is one of the most common ingredients in mineral springs, all those denominated *chalybeate* containing more or less of iron; which is more readily dissolved by saline bodies than any other metal; its distribution through the interior parts of the earth is also more general. When dissolved in natural springs, it is commonly by means of the vitriolic acid, either in a *fixed* or *volatile* state: when by the former, it imparts to the water the same properties that a very slight solution of sal martis does; but it is seldom obtained from mineral waters in such proportion as to afford crystals. There is one instance, however, related by Dr. Horsburgh, where this salt was procured in its pure crystalline state, from  
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the water of a spaw in the Hartfell Mountains in Scotland, in the year 1750.\*

With regard to the suspension of iron by the *volatile vitriolic acid*, Dr. Falconer very judiciously remarks, that when we are certain of the presence of the vitriolic acid and iron in a water, we can seldom obtain it in a crystallized form; as the vitriolic acid seems here to have been extracted from pyrites, which contains it in a volatile state; it is therefore decomposed on being exposed to the air, the iron falls down in form of ochre, and the water loses its chalybeate taste and qualities. † This circumstance accounts for the limpid, colourless appearance of these chalybeate waters when they first spring up; and for the yellow ochrous sediment deposited in the channels through which they run. *Fixed air* is also capable of keeping iron in a state of suspension in water; but, like the volatile vitriolic acid, deposits it when exposed to the atmosphere.

(b.) COPPER. Copper is easily acted upon, though not quite so readily as iron, by all the saline substances: with the vitriolic it forms *blue vitriol*, which is sometimes found native in veins

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\* Physical and Literary Essays, vol. i. p. 341.

† Essay on Bath Waters, vol. i. p. 57.

of copper, but never in the same pure unmixed state that it appears in when it is artificially obtained; yet sufficiently perfect to impart a cupreous impregnation to particular springs. Experience, however, has not afforded many instances of this sort, probably for these reasons, because copper is always precipitated from the vitriolic acid, when it comes into contact with iron, a metal more plentifully distributed through the mineral kingdom, and having a greater affinity with the vitriolic acid, than copper; and because the latter is also liable to decomposition when it is in contact with alkaline salts, or absorbent earths. Hence cupreous waters seldom retain their original impregnation till they spring from the earth, especially if they have had a long passage before they arrive at the surface. These waters are not, however, like the chalybeate kind, subject to spontaneous precipitation when exposed to the air.

(c.) ZINC. This semimetal has been found in great plenty in various parts of Europe, in England, as well as on the Continent; and in still larger quantities in the East-Indies. It is frequently extracted from the ores of other metals, and from *calamine*, which is its peculiar ore. We may, perhaps, be allowed to remark here, that  
fulphur

fulphur refuses all union with zinc, not only when it is applied pure, but also in the state of hepar sulphuris. This points out a method of purifying zinc; for, by throwing in fulphur, and applying heat, the fulphur will unite with the other bodies which the ore may contain, and leave the zinc pure.

Zinc is easily dissolved by all the acids, which have a stronger attraction to this metal than to any of the rest; accordingly, it precipitates all the others from their solutions in any of the acids; yet, zinc is rarely met with in mineral waters; and when it is, it is always by means of the vitriolic acid, with which it forms white vitriol; a salt sometimes spontaneously produced in its true crystallized form, though more commonly in that of white efflorescences, capable of solution in water, which proves them to be of a saline nature. The mines of Goslar afford examples of this kind.

As to ARSENIC, there have hitherto been no certain experiments that have demonstrated the presence of this poisonous mineral, in any waters that have been subjected to examination. If from this we may conclude, that they are never rendered unwholesome by it, how happy it is for the

animal creation that nature has made this salutary prohibition in its favour.

Arsenic is not easily soluble in water, and, in a natural state, is commonly so enveloped with sulphur, as to render it almost harmless. I know of no means, except where art has been employed, whereby water can be impregnated with it so as to prove deleterious. Yet it may happen, that particular springs may accidentally contain a small quantity of arsenic, because the miners are accustomed to make their way through rocks in mines, by means of fire, and hence may possibly be produced those arsenical fumes, which readily communicate their baneful effects to water.

From the foregoing considerations we may conclude, that the following substances, either separately, or in various combinations, do sometimes enter into the composition of different mineral waters, viz.

1. Fixed air ;
2. Vitriolic acid ;
3. Fossil, and vegetable alkalies ;
4. Epsom salt ;
5. Nitre ;
6. Common salt ;

7. Sal

7. Sal ammoniac, in the neighbourhood of volcanos ;
8. Simple, calcareous, felenitical, and aluminous earths, and the earth of magnesia ;
9. Hepar sulphuris, and sulphureous vapour ;
10. Bituminous bodies ;
11. Metallic substances ; as
  - (a.) *Iron* ;
  - (b.) *Copper* ;
  - (c.) *Zinc*.

## P A R T II.

OF THE METHOD OF ANALYSING  
MINERAL WATERS.

**W**E shall now proceed to lay down some general rules, which should be attended to in the examination of mineral waters; and shall describe some experiments, which may enable us to discover each of the foregoing substances when contained in water.

1. It is proper, in the examination of mineral waters, to take notice of the situation, soil, and face of the country in the neighbourhood. If hilly and mountainous, to describe of what materials the hills are composed; whether of calcareous matter, stalactites, gypsum, free stone, &c. Attention ought likewise to be given to the metallic minerals; and enquiry made whether there be any veins of iron, copper, zinc, lead, &c. It frequently happens that springs take their rise from the bottom of mineral veins, and therefore a knowledge of the nature of these, may throw light on the contents of the water.

If

If there be any strata of coal, alum, rock-salt, &c. they should be noticed in the account; as all these particulars are of importance in the history of mineral waters.

2. Our experiments should always be made on the water immediately after it is taken up from the spring; because some of the principles, mentioned in the foregoing pages, are of so fugitive, and volatile a nature, that they fly off in a very short time; and might, if the water were conveyed to a distance, though apparently well secured in glass bottles, entirely elude our observation.

3. The sensible qualities of the water should be examined, such as its colour, taste, smell, and also its temperature by a well graduated thermometer. The scale of Fahrenheit is now commonly employed for this purpose. Those springs that are generally reckoned *cold*, are of a middle temperature between the heat of summer, and the cold of winter, which, in this climate, is about 48 degrees. In countries where the summer's heat exceeds, and the winter's cold falls short of ours, the middle degree may be about 50°, or 52°.

Variations, in these respects, sometimes depend upon the elevation of the ground from whence

the spring proceeds. Those who have attended to this circumstance have found, that springs issuing from the sides of high mountains, and at a considerable distance from their base, prove remarkably colder than those, which flow immediately from the bottom of the mountains. This is easily explained, since it is well known that mountains are always colder, the higher they rise; being there involved in a colder atmosphere.

In general, therefore, there is no rule by which we can denominate a spring *cold*, except that of observing the middle temperature between summer and winter; or the state of the air in caverns, at a considerable depth underground; and comparing the heat of the water with either of them.

All springs warmer than this middle temperature are called *hot*; and are of different degrees of heat from  $48^{\circ}$  to  $150^{\circ}$ , by Fahrenheit's thermometer. Some few of them will coagulate the albumen ovi, like the common fire.

As the quantity of water thrown out by many of these springs is very considerable, it shews that there is some immense source of heat, near which these waters run; and that, in all probability,  
they

they are conveyed from a great distance, before they break out in the state in which we observe them.

When we are taking the temperature of any mineral water, it may be proper to compare it with that of a common spring in the neighbourhood.

4. As the substances, from which medicinal springs derive their efficacy, are often contained in very small proportions, it is sometimes not easy to ascertain, whether they are present or not. On this account it will be necessary, that a large quantity of the water be evaporated, in order to obtain a sufficient portion of precipitated matter, for examination. In doing this, as the subject may be injured if long exposed to heat, it will be proper to evaporate only about a pint of the water at once, in a vessel of glass, or china, of a cylindrical form, not too wide, and if it converge a little at the top, it would be still better. This vessel, when filled about half way up with the mineral water, may be placed in a water-bath, till the water it contained be evaporated to about  $\frac{1}{10}$ th part, which should then be poured out into some other vessel, and another pint of the mineral water be put into the evaporating cylinder.

This

This process ought to be repeated, from time to time, till several gallons of the water have been evaporated in this manner, and a considerable number of concentrated residua are obtained; which should, at last, be all poured into the evaporating vessel; and the evaporation carried on, till the matter begins to separate, or to crystallize. The process may then be conducted in the manner usually directed, for the crystallization of salts. The earth, salts, and other matters, thus obtained, are to be carefully separated from each other, and subjected to chemical examination.

5. Besides evaporating the water in this manner, which is always proper, and in most cases necessary, to obtain the salts in their true crystalline forms, there are other trials to be made by MIXTURE, or the addition of certain bodies, which produce effects upon the water, according to the nature of the different substances it may contain. This method may also be of use, when applied to the evaporated residuum.

In order to render our experiments accurate, great care should be taken, that all the substances we employ in making them be genuine; and that the solutions of metals be kept in vials with ground glass stopples.

Besides

Besides a Fahrenheit's thermometer, that is known to be properly graduated, we should be provided with

1. A pint, or two, of distilled water ;\*
2. An infusion of litmase in distilled water ;
3. An infusion, or fresh syrup, of violets ;†
4. A solution of corrosive sublimate in distilled water ;
5. *A saturated solution* of lead in the nitrous acid ;
6. A solution of saccharum saturni in distilled water ;
7. Pure vitriolic acid, diluted with distilled water ;
8. A solution of lead, *not quite saturated* with the lead ;
9. Ley of Tartar ;
10. A solution of silver in the nitrous acid, *not fully saturated* ;
11. Quicklime, in a vial closely corked ;
12. An infusion of galls in distilled water ;
13. Caustic volatile alkali, or spirit of sal ammoniac prepared with quicklime.

The

\* The water should, for this purpose, be distilled in glass vessels.

† If we employ syrup of violets, it should be fresh, and truly prepared, as the colour is sometimes artificial, and will not then answer the intention.

The last general rule we shall mention is, that all experiments on medicinal waters ought not only to be made at the spring head, as has been already remarked, but, that the changes produced may be more accurately observed, each experiment should be repeated, at the same time, with distilled water, and the purest sort of fountain water that can be procured. The mixtures should likewise remain undisturbed for twenty-four hours at least; that the conclusions may be rendered clear and decisive.

1. *Experiments to discover the presence of fixed air.*

When *fixed air* is present in water, it shews itself, in some measure, by several sensible qualities; such as a brisk, sparkling appearance, like that of fermented liquors, when the water is poured from one glass to another; or, if it be strongly agitated in a vial, a hissing noise may be heard, on taking out the cork, which is occasioned by a quantity of this air rushing out. It also communicates to the water, a pungent, subacid taste; and sometimes an inebriating quality; and is of so volatile a nature, that it soon evaporates, when exposed to the atmosphere, especially if a small degree of heat be applied to it.

Waters containing fixed air, therefore, may be easily distinguished from those impregnated with  
an

an actual acid ; which neither lose their taste, by being exposed to the air, nor by a moderate degree of heat. If the infusion of litmase, which is of a purple colour, be added to water containing *fixed air*, it is immediately changed into a bright *red*. The same effect is produced upon it, by an *acid*; and to determine to which of these the change is owing, it is necessary to expose the mixture to the atmosphere. If the red colour depends on *fixed air* it will gradually go off; if on an *acid*, it will remain.

Another mark of the presence of fixed air, is, that it precipitates lime, from lime-water; and thereby causes the mixture to put on a milky, or turbid appearance. The reason is, that calcareous earth, deprived of its air by calcination, is rendered soluble in water in much larger proportion, than when mild. Accordingly, when lime-water is dropped into water containing fixed air, the latter immediately attaches itself to the lime, and renders a part of it insoluble; which, instantly falling down to the bottom of the glass, in the form of a mild calcareous earth, makes the mixture turbid. And though a superabundant quantity of fixed air, might possibly re-dissolve the precipitated earth; yet since, perhaps, no  
mineral

mineral water naturally contains so much fixed air as would be required for this purpose, the experiment is conclusive.

If, therefore, the taste, and other qualities before enumerated, are predominant in any mineral water; and the variations in appearance above-mentioned are observable, when the infusions of litmase, and lime water are added; there is every reason to presume, that the water is impregnated with *fixed air*.

If we are desirous of measuring the *quantity* of fixed air contained in any mineral water, we may fill a glass bottle, of any size we please, with the water, and fit a cork to it; which should be perforated, so as to admit a small glass tube; to the cork a wet bladder must be tied, so tight, as not to allow any air to escape, except into the bladder. The bottle is then to be placed in a vessel of cold water, which should be gradually and *cautiously* heated, till the fixed air be expelled, and collected in the bladder; which is then to be tied quite close at the neck with a string. To the upper part of the bladder, a small leathern syphon, perfectly air tight, should be previously fixed, and tied firmly at the end. When all the air is thus obtained, which the water can afford,  
let

let the extremity of the syphon be introduced into the neck of another vial, nearly filled with common water, and inverted into a basin, containing a sufficient quantity of water to cover the mouth of the inverted vial. The ligature, at the end of the syphon, should then be slackened, and pressure applied to the bladder, which will force the air through the syphon into the vial; and cause the water to descend into the basin, in proportion as the vial fills with air. By marking the place on the inverted vial, to which the water first reached, and observing how far the water has descended, after all the air has been admitted, we may obtain a tolerably exact idea of the quantity of fixed air, contained in a certain measure of the mineral water.

2. *Experiments to discover the presence of an acid, in water, in a separate state.*

(a.) It has been remarked before, that no acid, except the *vitriolic*, and even that very seldom, has ever been met with in mineral waters, in a *separate* state: but that an imperfect vitriol, or alum, may sometimes be found in them, that contains a superabundant acid. If any of this acid be present, it may be easily discovered by the addition of a few drops of the infusion of  
litmase,

litmase, or fresh syrup of violets. The first is of a purple colour, and has a very sensible effect on acids; the latter is blue; but when either of them is added to acidulous waters, the mixture immediately assumes a red colour, which it will retain, though long exposed to the atmosphere; a circumstance, which, as has been before observed, serves to distinguish these from waters impregnated with fixed air.

Waters of the acidulous kind seldom contain the acid in such quantity as to cause an effervescence with a mild alkali.

When the *volatile* vitriolic acid is present in water, in a separate state, it discovers itself by a smell resembling that of burning sulphur.

*Experiment to discover the vitriolic acid in a combined state.*

(*b.*) When the vitriolic acid is in a state of combination with an alkali, an earth, the inflammable principle, or metallic body, it may be discovered by a solution of lead in the nitrous acid, *not quite saturated*. The lead will not then be precipitated, either by an alkaline salt, or calcareous earth; because the superfluous acid will saturate these, and will also prevent the precipitation of a metal.

metal. This will not, however, hinder the lead from uniting with the vitriolic acid, nor from forming with it a substance incapable of solution in water; and which, on that account, always renders the mixture turbid, and causes a precipitation.

### 3. *Experiments to discover the presence of alkalies.*

An alkaline salt, when unassociated with other bodies, is very readily distinguished by the addition of fresh syrup of violets; which is immediately converted by it into a lively green colour. This syrup affords a nicer test of the presence of an alkali, than it does of the acid before mentioned. If water contains an alkaline salt in large proportion, an effervescence may be perceived when the vitriolic acid is added.

To ascertain whether the alkali be of the *fossil* or *vegetable* kind, there is no other method but that of collecting a portion of the salt which remains, after a large quantity of the water has been evaporated; combining it with some of the mineral acids; evaporating the mixture; and observing the form of the crystals; which will afford a true distinction.

If we desire to be more particular, and to know whether the alkali be *fixed*, or *volatile*; we may easily discover whether it be the latter, by adding a few drops of the solution of corrosive sublimate; which, if there be the smallest portion of volatile alkali in the water, will produce a white, turbid appearance. If the alkali be of the *fixed* kind, the precipitate, formed by the foregoing solution, will be of a *reddish brown* colour. But it may be remarked, that a precipitation is not so readily occasioned by a small quantity of *fixed* alkali, as it is by the most minute portion of the *volatile*.

Another method of discovering the volatile alkali has been mentioned by authors, viz. that of adding to the water a calx of copper, which, being readily dissolved by the volatile alkali, suddenly converts the mixture into a fine blue colour. But as this experiment does not succeed if the quantity of copper contained in the water be very small, it would be more eligible to put some verdigrease into a glass receiver, and to distil over to it from a retort, a few ounces of the mineral water. During the process, the volatile alkali would rise, before any other ingredient the water might contain, and would immediately change the colour of the verdigrease to a deep blue.

#### 4. Experiments

#### 4. *Experiments to discover the presence of Epsom salt.*

We have mentioned before, that the true *Glauber's salt* is very rarely found in mineral waters; nor is it easy to discover it by *mixture*. The most clear and decisive method would be, that of examining the salt obtained by evaporation.

The crystals of *Glauber's salt*, as well as those of *Epsom*, are hexagonal prisms, truncated at each end; but the following experiment will easily distinguish the two salts from each other.

If *Epsom salt* be dissolved in water, the addition of a little ley of tartar will immediately cause a milky appearance. The reason is obvious. The vitriolic acid of the *Epsom salt* attaches itself to the alkali in the ley of tartar, and instantly dislodges the earth of magnesia, which falls to the bottom of the glass. This precipitate, when added to diluted vitriolic acid, will again form the true *Epsom salt*.

It may be proper to observe here, that in precipitating magnesia from *Epsom salt*, the mixture should be kept in a warm place till the precipitate be settled; as the experiment will not always succeed when the water is cold. No change is

produced when the fixed alkali is added to a solution of the true Glauber's salt.

5. *Experiments to discover the presence of nitre.*

The nitrous acid is sometimes combined with alkalies, and possibly may sometimes be joined to earthy substances. When in the former state, it forms *nitre*; which is only to be discovered with certainty when contained in water, by evaporation, by deflagrating the salt with charcoal, and by an examination of its crystals; which are hexagonal prisms terminated by a pyramid of the same number of sides.

If we suspect that the nitrous acid is united to an earth, it will be proper, during the evaporation, if any nitrous matter appears, to take a quantity of the concentrated water, and add to it a pure fixed alkaline salt, such as salt of tartar, which will unite with the nitrous acid, form a true crystallized nitre, and leave the earth behind.

The property which nitre possesses, of imparting a red colour to animal substances, is not peculiar to nitre alone, since some other salts produce this effect, though not in so great a degree.

6. *Experiments to discover common salt in water.*

The crystals of common salt, obtained by evaporation, are of a cubical figure ; which distinguishes this, from every other saline substance, hitherto met with in mineral waters. This salt also possesses another peculiarity, that of decrepitating in the fire. And we have a very nice test of it, when dissolved in water, by means of the solution of silver in the nitrous acid ; which ought, however, in this case, to contain a little more acid than is necessary to keep the silver dissolved, that the latter may not be precipitated by an earth, or alkaline salt. The superabundant acid will not prevent the metal from uniting with the muriatic acid, and forming with it a *luna cornea*, a substance insoluble in water, consequently incapable of suspension in it ; and on that account the mixture not only becomes instantly turbid, but deposits a copious, shining precipitate.

The solution of silver has likewise been commonly employed, and represented, as a test of the vitriolic acid ; but Dr. Black has found, by actual experiment, that this supposition is ill founded. If we take pure distilled water, and add to it a small quantity of the vitriolic acid ; and then

drop in some of the solution of silver, we shall find that it will mix with the water without rendering it turbid.

It has likewise been maintained, that the solution of lead is rendered turbid by the muriatic acid, in the same manner as it is by the vitriolic ; but this opinion is as erroneous as the former.

7. *Experiments to discover sal ammoniac in water.*

When we have obtained a sufficient quantity of saline matter by evaporation, it will be easy to distinguish an ammoniacal salt from one composed of the marine acid and the fixed alkali, by the addition of quick-lime. This, by uniting with the muriatic acid, detaches the volatile alkali in its pure state, so as to strike very sensibly, the organs of smell ; especially if heat be applied.

8. *Experiments to discover earthy bodies in water.*

(a.) CALCAREOUS EARTH. When earth is contained in water, in any considerable quantity, it is generally of the calcareous, or felenitical kind ; the simple earths being only diffused, or lightly suspended, in it. If calcareous earth be present in a separate state, it is readily discovered by adding to the water a few drops of the *saturated*  
solution

solution of lead in the nitrous acid, which is always rendered white, and the lead is instantly precipitated by the smallest portion of this earth. The reason is, that the nitrous acid forsakes the metal, and attaches itself to the earth. But that the experiment may succeed, it is necessary that the nitrous acid be *fully saturated* with the lead; for, if the solution contains any redundant acid, it may saturate the earth, and prevent the precipitation.

To determine the proportion of earth contained in a given quantity of the water, we must have recourse to evaporation; and when the whole is reduced to dryness, the earthy matter should be carefully separated from the saline, and its weight ascertained. To a portion of this residuum we may apply a few drops of any of the acids, with all of which it will effervesce, if it be of the calcareous kind. These waters do not curdle soap, because they are not, like the selenitical waters, impregnated with an acid combined with an earth.

(*b.*) SELENITES. Calcareous earth is frequently found in water united to the vitriolic acid, and in that state obtains the name of *selenites*. This combination is discovered by the addition of a

little fixed alkali, or ley of tartar, which detaches the earth, and renders the mixture turbid; especially if it be placed in a warm situation; for that greatly favours the precipitation of the earth. The earth, thus precipitated, will be re-dissolved by diluted vitriolic acid, with which it forms again a true selenites.

Selenites may also be obtained by evaporation, and is then distinguishable from calcareous earth, by the application of an acid, with which it produces no change, or effervescence.

Waters which contain selenites, in any considerable quantity, curdle soap; the reason of which is obvious; the alkali of the soap, by uniting with the acid of the selenites, dislodges the oil, and allows it to rise to the top.

(c.) EARTH OF ALUM. When alum enters into the composition of a mineral water, it may be distinguished by the acidulous taste it communicates to it, arising from the superabundant vitriolic acid which the aluminous liquor contains. It is also discoverable by the red colour it produces with the infusions of blue vegetables, or of litmase. Its earth may likewise be known with certainty, by adding a little ley of tartar, as in  
the

the last experiment: this precipitates the earth from the acid which kept it dissolved, and renders the mixture turbid. The precipitate thus produced, will form with diluted vitriolic acid an astringent liquor, which exactly resembles a solution of alum.

(d.) With regard to the EARTH OF MAGNESIA, and the method of distinguishing it, see the experiments proposed for discovering Epsom salt, at page 67.

9. *Experiments to discover sulphur in water.*

(a.) HEPAR SULPHURIS. It has already been observed, that when sulphur is suspended in mineral waters, in any considerable quantity, it is in the form of *hepar sulphuris*. The common experiment for discovering it, is, to add an acid to the water, which by saturating the alkali, or earth, which the *hepar sulphuris* contains, causes the sulphur to precipitate, and occasions a strong sulphureous smell.

Sulphur, when thus precipitated, or obtained by evaporation, may easily be known by the taste and smell peculiar to itself; and by its emitting a blue flame when placed on a hot iron. If a  
small

small portion of sulphur be suspended by *fixed air*, exposing the water to the atmosphere will be sufficient to precipitate it.

(*b.*) SULPHUREOUS VAPOUR. This is a far more frequent ingredient in medicated waters, than sulphur per se; but is so extremely subtile, that it is impossible to obtain it in a solid form. The smell, however, which resembles that of *hepar sulphuris*, or the scourings of a gun, is so very remarkable, that it is alone sufficient to distinguish these waters from all others, when taken fresh from the spring. The following experiment however, affords another nice test of the presence of this principle. A piece of paper, upon which lines are drawn with a pen dipped in the solution of *saccharum saturni*, and then dried, may be placed over a glass nearly filled with the water, and kept down with a piece of flat glass, or tile. If the water be impregnated with a sulphureous principle, the lines on the paper will soon become visible, and of a dark brown, or black colour. But it is to be observed, that this experiment will not succeed unless the water be fresh.

Another method which some employ, is, that of putting a piece of polished silver into the water, which will be converted into a brown, or  
black

black colour, according as the water contains more or less, of this sulphureous principle.

10. *Experiments to discover bitumens in water.*

BITUMENS are discoverable in mineral waters by the sight, the smell, and the taste; and some of them readily catch fire, when the flame of a candle is applied to their surfaces. A little of the matter floating on the surface of the spring may be collected, and afterwards boiled in linseed oil; if it dissolves in it, an inference may safely be made, that it is of a bituminous nature.

*Inflammable air* exhibits nearly the same appearances on the surface of water, that thin bitumens do: the film reflects coloured rays, and the water generally deposits a reddish brown sediment; especially when the inflammable air is generated from pyrites.

11. *Experiments to discover metallic bodies in water.*

(a.) IRON. The infusion of galls in distilled water, supplies us with an accurate test of this metal, when present in water; for, it gradually changes the mixture to a purple, or black colour. Yet, if the water be only slightly impregnated with the chalybeate principle, several hours are  
required

required before any alteration takes place; and sometimes the addition of a few drops of lime-water is necessary.

Those waters, in which iron is suspended by the *volatile vitriolic acid*, or by *fixed air*, distinguish themselves by the ochrous sediment they deposit in the channels through which they run; as well as by the changes they produce with the foregoing infusion.

(b.) COPPER. The most remarkable effects are produced on cupreous waters, by the caustic volatile alkali, which forms with them a fine deep blue. But although  $\frac{1}{100}$  part of a grain of copper dissolved in a pint of water, is sufficient to tinge it, when the volatile alkali is added to it; yet it is remarkable, that there are few springs impregnated naturally with copper in this proportion,

Another method of discovering copper, is, that of putting a piece of iron-wire into the water, and keeping the vessel in a warm place; by which means the copper will be deposited on the surface, and give it the appearance of copper-wire.

(c.) ZINC. This metal may be discovered by evaporation, and the examination of the crystals, which

which are like those of white vitriol, pyramidal parallelopipeds. The taste of such waters is nauseous, and styptic. And if an alkaline salt be added to them, it precipitates the zinc from the vitriolic acid, which suspended it. If this precipitate be collected, and put between two plates of polished copper, and then exposed to heat, it will tinge them with a bright *yellow* colour.

ARSENIC, as we have before observed, seldom enters into the composition of a mineral water, perhaps never, unless where art has been employed. In that case, it may be discovered by examining the residuum of the water, when evaporated to dryness: a small portion of this placed on a red hot iron, will emit fumes which smell like garlic. If another portion of this residuum be placed between two plates of bright copper, and then exposed to the fire till the plates become red hot, the arsenic will penetrate them, and render them of a *white* colour.

## P A R T III.

## OF HARROGATE WATER.

I. *Of the situation, soil, &c.*

I N the prosecution of our plan, some account should now be given of the situation, face of the country, and nature of the soil at, and in the neighbourhood of, Harrogate.

Under the name of *Harrogate* are comprised two villages standing about a mile distant from each other, which, from their situation, are called *High* and *Low Harrogate*; the ground rising with a gradual elevation from the latter to the former.

The wells which afford the sulphureous water are four in number, and are situated at *Low-Harrogate*; which being encompassed with hills, its prospects are consequently limited: it is, notwithstanding, dry, warm, and tolerably well sheltered. As you approach *High-Harrogate*, the prospect begins to open, and includes the extensive forest of *Knaresborough*, lately inclosed; and  
a large

a large tract of cultivated country, at a considerable distance.

The air at Harrogate is cool, pure, and salubrious. The Inns are equal to most in England; and their accommodation is suited, as well to the weak and enervated, as to the young and healthy, whose object is amusement, or society.

A large part of the forest has been designedly left uninclosed, as a convenience to invalids, who may be under the necessity of taking frequent airings on horseback, and are unequal to distant rides. But for those in better health, there are many allurements to induce them to extend their excursions. The neighbourhood is ornamented with beautiful seats and pleasure-grounds; it may be sufficient to mention Plumpton, Harewood-House, Studley, and Hack-fall: places which mark not only the elegant taste of the owners, but their civility and indulgence to strangers, who are conducted through them, with proper attention, by persons purposely appointed. To these delightful scenes, the love of rational recreation frequently invites the company from Harrogate, where, amidst the various objects of admiration, the valetudinarian forgets his weakness, and the hypochondriac his cares.

At the distance of two miles from Harrogate, is KNARESBOROUGH ; the beautiful, romantic situation of which, and its numerous curiosities, claim the attention of the naturalist and the antiquarian. The town is situated about eighteen miles north-west of York, and is built chiefly on a rock of lime-stone; which also forms the bed of the river *Nyd*, to the south-west; interrupting, in many places, the smoothness of its banks with steep precipices, which are beautifully ornamented with hanging foliage, and give a delightful shade to the water beneath.

On the margin of the river is still to be seen a fragment of the castle; once the pride and defence of the inhabitants, but which now affords a lamentable example of the rage of party, and the devastations of time. On the opposite side, parted from the river by a narrow path, is the remarkable petrefying spring called the DROPPING-WELL; art and industry having conspired to make the water descend in drops, successively like a shower, from the top of a high, projecting, semi-circular rock.\*

The

\* In September 1783, I made the following experiments on this water.

EXP. I. A few drops of the ley of tartar were added to a glass of the water; the mixture immediately became milky,  
and

The country, in the vicinity of Knaresborough,  
is well cultivated, and agreeably diversified, with  
G                      plantations,

and let fall a white precipitate. This being separated from the water, effervesced strongly with diluted vitriolic acid, yet was not dissolved by it, but formed with it, an insoluble compound of the gypseous, or selenitical kind, which was of a remarkably white colour.

R E M A R K.

IN PART II. 8. (*b.*) Reasons are given why felenitical waters cause a precipitation with the fixed alkali to which we here refer : and shall only farther observe, that this water is possessed of another distinguishing property of such waters as contain felenites, which is, that it curdles soap ; and that more readily than any other water I ever tried.

EXP. II. The saturated solution of lead, dropped into this water, produced no sensible change till the mixture had stood some time ; when a small portion of a grey coloured sediment was deposited.

R E M A R K.

For an explanation of this experiment, see PART II. 8. (a.)

EXP. III. The incrustations formed upon mosses, and other vegetable substances, taken from this spring, effervesced slightly with diluted vitriolic acid.

R E M A R K.

This experiment proves, beyond a doubt, that the water contains calcareous earth, in a separate state.

EXP. IV. A quantity of this water was evaporated in the heat of a water-bath, and yielded a precipitate evidently of two kinds; the one, white, of a crystalline appearance, and in larger proportion; the other of a yellowish brown colour. The former was insoluble in distilled water, and caused no ebullition with diluted vitriolic acid; the latter effervesced strongly with the same acid, but was not dissolved by it.

R E M A R K.

From all these experiments it is very clear, that the petrefying spring at Knareborough, contains a considerable quantity of *selenitical*, and a smaller proportion of *calcareous earth*, in a separate state.

plantations, hills and vallies. The soil in the neighbourhood of Harrogate, consists of simple, and calcareous earth ; free stone ; felenitical crystals ; coal ; alum ; metallic veins, and ores, particularly those of pyrites.

There are several springs containing chalybeate impregnations, such as the *Old Spaw* at High-Harrogate ; the *Tewit-Well* upon the Forest ; and *St. Magnus's Well* situated full west of High Harrogate, formerly in great repute as a cold-bath, and for which purpose it is still employed. The bath is surrounded with a wall ; and there is a convenient dressing room for the accommodation of the bathers.

If to these we add the sulphureous bog, the wells at Low-Harrogate, and two other springs which break out near the road side leading to Knaresborough, one of which is a chalybeate, the other a sulphureous water ; we shall be led to reflect with astonishment, on the variety of materials, of which this country is composed, and how irregularly the metallic veins are distributed under its surface.

## 2. *Of the sensible qualities of Harrogate Water.*

Before we enter upon the sensible qualities of this water it may not be improper to observe, that  
the

the four sulphureous springs appear to take their rise from a large bog, situated about four or five hundred yards from the wells. This bog consists of a dark coloured, thick, fetid water; and is encompassed, on all sides, by small dry hills composed of calcareous earth, pyrites, &c. so that as Dr. Short\* observes, no other springs can get into it; and from it there is but one outlet, by which the water can discharge itself. From thence it runs softly along an easy, gravelly, descent, till it is lost, or swallowed up, under a hedge, at the head of some inclosed fields. From this place, the water seems to be filtered underground, for the space of four or five hundred yards, and then springs up again, perfectly transparent, in the valley below; where it forms four basons, or wells, which are walled round, and covered in at the top.

Harrogate water, when taken fresh from the spring, appears as limpid and colourless as pure fountain water; yields a few air-bubbles when poured into a glass; emits a strong sulphureous smell, like that of bilge-water, or the scourings of a gun; and has a saline, briny, nauseous taste. If it be exposed to the atmosphere, in an open glass, for twenty-four hours, it gradually changes

to a light pearl colour ; loses its fetor, and deposits a whitish sediment. It does not dissolve soap, but instantly decomposes it. Taken internally it operates as a mild purgative, without causing any uneasiness, or gripings in the bowels.

That the comparative weight of this water might be exactly ascertained, I filled a Florentine flask with it up to the neck, marked the place with a diamond to which it reached, weighed the whole, and found it amounted to one pound four ounces. The flask was then emptied, and filled again, precisely to the same height, with distilled water ; on comparing the difference, the Harrogate water proved to be heavier by 95 grains. The flask was filled a third time, with the purest fountain water I could procure, and the sulphureous water was found to exceed it in weight by 93 grains. The temperature of this water, in the basin where it springs, is 48 degrees by Fahrenheit's scale ; while that of a rivulet which runs close to the wells, and which springs at no great distance from them, is 53°.

### 3. *Experiments and remarks on the contents of Harrogate water.*

That the reader may more clearly comprehend the nature and design of the following experiments,

ments, he is desired to refer to the directions before given for analysing mineral waters in general, in part II. and to compare each experiment with the rules there mentioned, in the order in which they succeed each other.

### EXPERIMENT I.

A small quantity of lime-water was added to a glass of the sulphureous water, taken fresh from the spring, which produced no change, though the mixture stood several hours undisturbed.

### EXPERIMENT II.

The infusion of litmase was dropped into a glass of the water, but it caused no visible alteration in the purple colour peculiar to this infusion.

### REMARKS.

It has been before observed in part II. that lime is instantly precipitated from lime-water, by *fixed air*; and that the fine purple colour for which the infusion of litmase is so remarkable, is converted by it into a bright red. As no change was observable when these were added to the water, we may conclude that it is not impregnated with fixed air; and that the few air-bubbles which appear in it consist solely of atmospheric air.

The

The infusion of litmase is also a nice test of an *acid* in a *separate* state ; but as it produced no effect in experiment II. it appears, that the water contains not the least portion of the vitriolic acid per se.

All the other marks of the presence of fixed air, or of an acid, are likewise wanting in this water ; it is neither sparkling to the eye, nor pungent, nor acidulous to the taste.

### EXPERIMENT III.

When a few drops of a solution of lead, which contained a little redundant acid, were mixed with a glass of the water, it deposited a small portion of a brownish sediment.

### REMARKS.

This experiment was made with a view of discovering whether the water contained the *vitriolic acid* in a state of combination. And the solution of lead here employed, was designedly left unsaturated with the lead, that there might be no precipitation caused, either by an alkali, earth, or metal, but by the vitriolic acid alone. See experiments for discovering an acid in a combined state, in part II. 2. (b.) page 64.

From

From this experiment we may be induced to believe, that Harrogate water is slightly impregnated with an acid combined with some other substance, which may probably be the inflammable principle.

#### EXPERIMENT IV.

To a glass of the water were added a few drops of the fresh syrup of violets; which produced no immediate alteration; but in three or four hours the mixture assumed a pale green colour, which it retained.

#### REMARKS.

The result of this experiment favours the supposition that the water may be impregnated with an *alkaline salt*. If so, it can only be in a very small proportion; because the change produced by the syrup of violets was slow, and gradual, and the colour, at last, only a *pale green*; far different from that full deep green, which even a very moderate quantity of an alkali invariably produces.

No effervescence was observable when the vitriolic acid was mixed with the water.

#### EXPERIMENT V.

When a few drops of the solution of corrosive sublimate were mixed with a glass of the water,

it was suddenly changed into a turbid mixture, which, after a few hours, deposited a brownish sediment.

#### R E M A R K S.

In order to distinguish the nature of the alkali which appeared to be present by the IV. experiment, the solution of corrosive sublimate was employed in this ; and from the colour of the precipitate, which was a *light brown*, there is reason to suppose, that it is the *fixed* alkali ; because the smallest portion of the *volatile*, produces, with the above solution, a *white* turbid appearance.

#### E X P E R I M E N T VI.

A large quantity of the water was evaporated, and a salt obtained, the crystals of which were of a cubical figure. A portion of this salt was dissolved in distilled water, to which were added a few grains of fixed alkali ; but no visible alteration ensued.

#### R E M A R K S.

This experiment, according to the order expressed in Part II. was designed to ascertain whether the water contained *Epsom salt*. But since  
the

the crystals were found so totally different from the rectangular, prismatic figure of that salt; and as the solution of the salt did not change its appearance, when an alkali was added, there is reason to believe, that Harrogate water is not impregnated with Epsom salt.

#### EXPERIMENT VII.

A portion of the salt which was obtained by evaporation, did not, when mixed with charcoal, deflagrate in the fire.

#### REMARKS.

This experiment is alone sufficient to convince us, that the water does not contain *nitre*. And the opinion is farther confirmed by the shape of the crystals, which are cubes, and not hexagonal prisms terminated by a pyramid of the same number of sides, like those of *nitre*.

#### EXPERIMENT VIII.

A gallon of Harrogate water was carefully evaporated in the heat of a water-bath, according to the directions given in Part II. from which were obtained fifteen drachms of salt, the crystals of which were of a cubical figure, and muriatic taste.

taste. When put on a hot iron they did not melt, but decrepitated strongly. When mixed with charcoal, as has been before observed in Experiment VII. and thrown into a hot crucible, they did not deflagrate.

No effervescence, or precipitation appeared, on the addition of an acid, or alkali, to this salt, when dissolved in distilled water.

When a solution of silver in the nitrous acid was added to a glass of Harrogate water, a white precipitate was instantly formed, and fell suddenly to the bottom; while a dark coloured matter remained in the middle of the mixture, for several hours, and at last gradually raised itself to the top in the form of short wool.

#### REMARKS.

All the trials in this experiment plainly prove, that the salt which enters, in such large proportion, into the composition of Harrogate water, is of the *muriatic kind*. See the tests for discovering common salt in Part II. page 69.

As to the dark coloured matter which was suspended in the mixture, I am at a loss to account for it in a satisfactory manner; and shall, therefore,

therefore, decline it. Dr. RUTTY, refers it to the sulphureous principle which the water contains\*.

### EXPERIMENT IX.

It did not appear that quick-lime, when added to the salts and residuum which were obtained by evaporation, had any effect upon them.

### REMARKS.

Had the salt been of the *ammoniacal* kind, the quick-lime, by uniting with the muriatic acid, would have detached the volatile alkali in its pungent state; which would have discovered it immediately to the organs of smell.

### EXPERIMENT X.

A few drops of a saturated solution of lead, were added to a glass of the water, which immediately became milky, and deposited a greyish sediment.

From a gallon of the water, evaporated in Experiment VIII. were procured, besides the salt, xxvi grains of *earth*, which effervesced strongly with diluted vitriolic acid; but was not dissolved by

\* See RUTTY on Mineral Waters, Preface, p. 10. note f.

by it. A portion of this earth, thrown upon a hot iron, emitted vapours resembling those of burning sulphur ; but it produced no flame, nor was its weight much diminished by the heat.

#### REMARKS.

It has been observed in Part II. that a few drops of a saturated solution of lead, would instantly render water turbid, which contained the smallest portion of *calcareous earth*. As such a change was produced when that solution was added to a glass of Harrogate water ; as a strong effervescence was caused, by a mixture of the diluted vitriolic acid with the precipitate obtained by evaporation ; and as the precipitate proved insoluble in that acid, we may, from all these circumstances, conclude, that this earth is of the *calcareous kind*.

#### EXPERIMENT XI.

A little purified salt of tartar was mixed with a glass of Harrogate water, which became, in a few seconds, as white as milk ; and a white matter resembling curd, was presently collected on the surface : but after the mixture had stood undisturbed for some hours, a perfectly white sediment,

ment, gritty to the touch, fell to the bottom. A trial was made to dissolve soap in this water, but without effect.

#### R E M A R K S.

The figure of the crystals, and the experiments made on the salts of Harrogate water, clearly prove them to be of the muriatic kind. And as no alteration was observable, when the ley of tartar was added to a solution of these salts in distilled water, see remarks on experiment VI. we have no reason to suppose, that the changes produced in experiment XI. were occasioned by the presence of Epsom salt; but more probably, by *selenitical earth*; because the precipitate obtained by the addition of a fixed alkali to this water, effervesced slightly with diluted vitriolic acid, but was not dissolved by it; at least in very small proportion.

On adding the acid of vitriol to this earth, the sulphureous smell, which had gone off, during the time the mixture had been exposed to the open air, was re-produced, and remained for several hours.

From the result of these experiments it will appear, that Harrogate water contains, not only calcareous, but a small portion of *selenitical earth*.

Ex-

## EXPERIMENT XII.

A small quantity of the earth which was precipitated by the salt of tartar, was mixed with a little diluted vitriolic acid; but though a slight effervescence was produced, the earth was not dissolved.

## REMARKS.

It appears, by experiment II. that Harrogate water does not impart a red colour to the infusion of litmase; nor affords the least suspicion of an aluminous impregnation by its acidity, or astringency on the palate. These circumstances, joined to the result of the last experiment, are sufficient to establish this fact, that the water neither contains the earth of *alum*, nor *magnesia*. For with the former, the vitriolic acid forms an astringent liquor, resembling a solution of alum; and with the latter, a mixture possessed of all the qualities of Epsom salt.

## EXPERIMENT XIII.

Little or no change was observable by the eye, upon mixing a small quantity of the vitriolic acid with a glass of Harrogate water; yet it greatly  
increased

increased the sulphureous smell. The same acid dropped into another glass of this water, which had stood exposed to the air till it had lost its smell, re-produced the sulphureous stench; yet, in the mean time, only a very small precipitation was perceived.

#### R E M A R K S.

It has been observed, under the directions given for discovering *hepar sulphuris* in water, that the vitriolic acid added to such waters causes a precipitation; that it saturates the alkali, or earth, which kept the sulphur suspended; and that during the precipitation the sulphureous smell is always greatly increased.

In the last experiment, though the precipitate was very inconsiderable, yet as the sulphureous smell was increased, and even re-produced in the water which had lost it altogether; and as the earth obtained by evaporation, evidently emitted fumes, resembling those of burning sulphur; (see experiment X.) we may, perhaps, be authorized to assert, that this mineral water actually contains a small quantity of *hepar sulphuris*. But it is not probable that this is present in so large a proportion as to account for all the phænomena, which the following experiments exhibit.

Ex-

## EXPERIMENT XIV.

A few words were written on a piece of paper, with a pen dipped in the solution of saccharum saturni; when the paper was dried, the letters were invisible. The paper was then laid over a glass of the water, taken fresh from the spring; in a few seconds the writing became legible, and gradually acquired a deep black colour.

A piece of polished silver immersed in a glass of the water, began presently to be covered over with a brown coat; which received, by degrees, a deeper tinge, till at length, it became of a dusky black.

## REMARKS.

From the sensible qualities, as well as from the result of the preceding experiments, there can be no doubt, that Harrogate water is strongly impregnated with a *sulphureous vapour*. This is known to be of a subtile, fugitive nature; because it is so ready to escape when exposed to the air; and because it has a power of imparting colour to metallic bodies, at some distance.

I have ventured, in the foregoing pages, to throw out a supposition, that it is probable,  
sulphureous

fulphureous waters of the volatile kind, may receive their impregnation from a decomposition of hepar sulphuris, by means of the superabundant acid contained in aluminous slates. That this is the case with the mineral water which is the subject of our present enquiry, I am induced to believe, from an examination of the soil in the neighbourhood of the wells. The master of the Half-Moon-Inn, at Low Harrogate, had occasion, this year 1783, to dig for fresh water in the field behind his house; but, contrary to his expectations, the water he met with was so far from being pure, that it very nearly resembled the water at the sulphur-wells, both in taste, and smell. In the soil, which had been taken out in digging for this spring, I found some slates, which were so fully saturated with aluminous liquor, that being put on a hot iron, they swelled out into larger pieces, and exhibited to the eye, and afforded to the taste, every property of calcined alum.

Harrogate water may, therefore, probably run through strata, composed of such materials as these, and thereby suffer that decomposition \*, or

H change;

\* If the water were originally to contain hepar sulphuris, the latter would be instantly decomposed when it came in contact with the acid of alum.

change, which would entirely preclude the possibility of its retaining sulphur in substance, in any considerable quantity ; but which would generate the volatile, sulphureous principle, peculiar to waters of this class.

#### EXPERIMENT XV.

The vapour, which flies off from Harrogate water, does not catch fire at the approach of a lighted candle ; nor do we perceive by our sight, smell, or taste, that the water contains any *bituminous* impregnation.

#### EXPERIMENT XVI.

The infusion of galls, when mixed with Harrogate water, produces no change : nor does the water deposite an ochrous sediment in the channels in which it runs.

#### REMARKS.

From the last experiment and observation we may conclude, that Harrogate water is not impregnated with *iron*, either in the state of sal martis, or in combination with the volatile vitriolic acid, or fixed air.

Ex-

## EXPERIMENT XVII.

The caustic volatile alkali was added to this water, which caused no alteration in its appearance, except that it precipitated a small quantity of earth from it.

A piece of polished iron wire was put into the water, but it was not discoloured by it.

## REMARK.

These trials are sufficient to convince us, that nothing of a *cupreous* nature is contained in this water.

## EXPERIMENT XVIII.

The crystals obtained by evaporation were carefully examined; but neither their figure, nor taste, afforded any suspicion that the water contained zinc; nor any other metallic substance.

From the preceding experiments we may draw the subsequent, general conclusions, that Harrogate water is slightly impregnated with

1. Hepar sulphuris;
2. An alkali; though this is rather doubtful;
- H 2
3. Common

3. Common salt, in the proportion of fifteen drachms to a gallon ;
4. Calcareous earth, twenty six grains to a gallon ;
5. A small quantity of selenites ;
6. Sulphureous vapour in a very large proportion.

4. *General observations on the use of Harrogate water.*

In enumerating the medical properties of any particular spring, we ought not to overlook the salutary effects of pure elementary water, which, from the sudden cold it communicates, may be considered as a tonic ; and from its great fluidity, and permeability, as a deobstruent, attenuant, and corrector of acrimony in the blood and juices.

We are, however, led to place a still higher confidence in its virtues, when it forms the basis, and is made the vehicle of more powerful agents. Yet it is not, perhaps, from any particular principle with which a mineral water may be impregnated, that we are to estimate its virtues. These may depend on a variety of substances, so combined, as to supply us with a remedy of superior efficacy, materially different from every sim-  
ple

ple ingredient, taken separately, that the water may contain.

And it must be acknowledged, notwithstanding the improvements which later chemists have made in the method of analysing mineral waters, that some of their more active parts, on which their virtues probably depend, may lie so much out of our reach, as not to be the objects of sense, nor discoverable by any experiments \*.

Were we to pursue this subject, it would lead us to consider, how vain it is for us to attempt to imitate, by any artificial composition, the intrinsic virtues of natural mineral waters. It would also induce us to conclude, that although a knowledge of the constituent principles of these waters, so far as they are capable of being investigated, may supply us very rationally with authority to prescribe them, yet our opinions, respecting their medicinal virtues, would be better founded on a diligent observation of their effects upon the human body under disease.

HARROGATE WATER has long been held in high estimation for the cure of many obstinate chronic diseases; but as it is an active remedy, some

H 3

precautions

\* See WALL'S TRACTS, page 119.

precautions are required in its use. Twenty or thirty ounces, or three or four of the glasses in common use, are an ordinary dose, and in general sufficient for most constitutions, when taken at the interval of ten minutes, or a quarter of an hour, along with moderate exercise between every two glasses. The dose, however, ought to be varied, according to the state of the stomach and bowels, the strength of the patient, and the intention of the prescriber ; since the promiscuous use of the water, in different habits and constitutions, has been frequently found to produce injurious, instead of salutary effects. Many are the individuals who, in this respect, have fallen a sacrifice to prejudice, persuasion, and example, and have wantonly persevered in the use of large and repeated draughts of this water, in order to obtain its purgative operation ; though, from some peculiarity of constitution, they have experienced its inefficacy from one day to another, and have endured all the painful consequences of overdistension, giddiness, loss of appetite, and mental disappointment.

Nor have the disadvantages of this conduct ended here. Some have pertinaciously continued to drink the water, when circumstances absolutely forbade its use. Those, for instance, who labour under the  
debilitating

debilitating effects of an *atonic* gout, where, through advanced age, or want of vigour in the constitution, nature is unable to produce a regular fit, are in no need of evacuations; on the contrary, they require restoratives, and cordials: but having been informed, that some patients, during their stay at Harrogate, had experienced regular gouty paroxysms, they have flattered themselves their cases were similar, and they have accordingly pursued the same measures. Such examples I have known followed by a train of evils which no medicine could remove, and which at last have deprived the patients of their existence. The gout is a disease which requires a considerable share of medical precision. The man who attempts to treat it on improper grounds, will have reason to repent his temerity.

To return to the subject. In all cases, in which the water is required to act as a purgative, and does not answer that intention, after three or four, or at most five glasses, have been drank, it would be folly in the extreme to expect it from an increase of the dose. It would be far more safe and effectual, if the patient were to quicken its operation by the addition of half an ounce, an ounce, or more, as may be necessary, of Rochelle, or Glauber's salts, to the first glass of the water.

Or, if more agreeable and consistent with the patient's plan, and the advice of his physician, two or three of Rufus's pills, or a little lenitive electary, may be taken over night, which will greatly assist the operation of the water in the morning, and thereby render a large quantity of it unnecessary, as well as effectually prevent the inconveniencies of over-distension, giddiness, &c.

The bowels of some patients are so easily moved, that half a pint of the water, taken fasting, is fully sufficient, and sometimes proves an over dose. For this reason, every person ought to begin with small quantities, and increase them gradually, till the effects of the water are properly ascertained. An attention to this will preclude the necessity of any preparation, prior to its use, provided it has been judiciously recommended as a remedy suited to the patient's case.

It may, however, be proper for those who have travelled from a distance, to abstain from drinking large and repeated draughts of this, or any other mineral water, for a few days after their arrival; lest the too sudden application of a cold fluid, impregnated with active principles, to a constitution heated, or rendered feverish by exercise, and perhaps improper regimen, should be  
productive

productive of bad consequences. This is the more necessary to be observed, because it is not uncommon for this water to produce a sense of heat and universal fulness in those unaccustomed to drink it. The giddiness which some have experienced is, in almost every instance, caused by an over dose of the water when it fails in its purgative operation: though in very delicate and irritable habits, large draughts of cold water suddenly taken in, may, independent of any mineral impregnation, sometimes produce this effect; and I have known head-achs caused by it, which have continued for several hours. This shews that it is not always fixed air, as has been generally supposed, which produces this effect.

Though some disadvantages may attend the drinking of the water *cold* in a few instances, yet I would by no means recommend it to be warmed, at least upon the fire, as that robs it of some of its virtues, especially of its exhilarating quality, which seems to reside in that fugitive principle so readily expelled by heat; and which is so remarkably volatile, that it even escapes through the pores of a cork. This circumstance, exclusive of the advantages arising from change of air, &c. renders it necessary for those who are desirous of reaping all the services which  
the

this water may afford them, to drink it at the fountain head. For though it may retain its purgative quality when conveyed to a distance, it is apt to grow vapid, and to lose some of its best properties. I would, therefore, advise those, who are liable to be affected by draughts of cold water, not to heat this mineral water upon the fire, but to add as much common water, boiling hot, to every glass of it, as will be just sufficient to take off the chilness, and to drink it immediately after. For though the mineral water be by this means diluted, yet its virtues are not injured, and in some cases may be improved by it, particularly when it is prescribed as a remedy for glandular obstructions, as an attenuant, or as a corrector of the acrimonious state of the fluids.

In every case where cold water does not disagree with the patient, I would advise the Harrogate water to be drank cold, and immediately after it is taken from the well. This will be still more necessary to be observed by those who drink it with a view to its *diuretic* effects. It should also, in that case, be taken at much longer intervals than is customary: for instance, a glass of the water may be drank in the morning fasting, and repeated two or three times, an hour or two between every two glasses; the patient observing  
to

to keep abroad, as much as possible, in the open air. This will promote the determination of the water to the kidneys, especially if the weather be cool, and the patient be careful to use very moderate exercise, either on foot or on horseback, within such bounds as may not cause him to perspire much more than usual, when at rest.

When the water is drank with this intention, the spring and autumn, on account of the cool state of the atmosphere, are as proper seasons as any: for it appears, that the water possesses nearly the same medicinal virtues at all the different periods of the year.

Nothing has hitherto been said respecting the *chalybeate* springs, but that there are two of this sort at Harrogate; one called the *Old Spaw*, the other the *Tewit-Well*. They are both pleasant waters, and sufficiently impregnated with iron to answer our expectations from them as *chalybeates*,

The *Tewit-well* water has of late years gained a superiority over the other in point of reputation; though they seem to be nearly of the same strength.

Experience

Experience warrants a recommendation of their use, in general relaxation, and weakness, indigestion, fluor albus, and other complaints arising from these causes. But chalybeate waters have always been found prejudicial to plethoric constitutions, and to such as are liable to returns of hectic fever, periodic asthma, active hemorrhage, or any disease in which a feverish, or inflammatory disposition prevails. In the latter part of this essay, it is designed occasionally to remark the farther use of these waters, under the diseases they are appropriated to relieve.

VALETUDINARIANS, who seek relief from the sulphureous water at Harrogate, should be particularly cautious to live abstemiously ; as most of the diseases against which it has been found effectual, require a sparing plain diet, few of them a full one.

The luxury of the table, which of late years has become fashionable at Harrogate, should put the invalid on his guard, and serve him as a daily memento, that one error from intemperance may entirely defeat his designs in going thither, and send him back in worse health, than when he came.

There is a species of intemperance, arising from the temptations constantly presented, in  
which

which the healthy and voluptuous indulge themselves with apparent impunity; and which is apt to steal upon the invalid, greatly to his prejudice, and almost without his perceiving it. But it will do him no harm to remember, that no person, to whom a full diet is improper, ought to gratify his palate with a variety of dishes; and that it would be more to his advantage if he were never to eat to satiety of any one dish, but leave off with some remains of appetite, even at dinner. Every fresh dish, by creating an appetite for itself, leads to excess.

When hunger craves, we eat with pleasure of any plain dish which is placed near us; and when our relish for it is lost, it is an indication that nature is satisfied, and that we ought to desist from eating.

But what is more particularly injurious to an invalid, is the use of animal diet at supper, especially if he has long been accustomed to a vegetable one.

Animal food and fermented liquors, taken liberally twice a day, if their effects are not counteracted by the daily habits of laborious exercise, more especially if supper be made the principal meal,

meal, are apt to induce a plethoric state of the body, of all others the most dangerous, and of which the individual entertains no suspicions. On the contrary, he plumes himself with the idea that he enjoys high health; and at the hazard of life, indulges himself in every species of voluptuous excess; till at length, disease overtakes him in his career, and suddenly reveals to him the fallacy of his judgment.

If a person be naturally delicate and weak, or has been rendered so by a series of bad health, he is little able to withstand the inroads which intemperance makes on the human constitution. Yet there are many, who, under these circumstances, fall victims to their own indiscretion.

There is, however, a generous temperance, in which a few individuals may indulge with impunity. But as it is impossible to advance rules which will suit all constitutions, let every man reflect on the quantity and quality of the food, which he has always found to sit light and easy on his stomach, without causing heaviness, indigestion, or aversion to exercise, and never exceed in either of these; he will then seldom be at a loss in prescribing for himself salutary rules of diet.

It

It is not always from ignorance that men err in respect to regimen. They are, and have long been, acquainted with the baneful consequences of intemperance. Resolution is therefore more wanted than precept, and without that, all our reasonings will avail nothing.

What has been said of intemperance in eating, is as applicable to excess in drinking. Whoever exceeds an exhilarating glass, will feel a proportional degree of languor, when the cordial effects of wine, or any other inebriating liquor, are gone off. Different constitutions, it is true, and the habits of individuals, admit of different degrees of indulgence; and what may be deemed intemperance in some, will be no more than moderation in others. A chearful glass, within the bounds of moderation, frequently enlivens every active faculty, both of the mind and body.

A person's own feelings, therefore, will perhaps be no bad director in regard to diet and regimen: "Every man at forty," says Dr. Cheyne, "is either a fool, or a physician."

I am conscious that the rules I am prescribing, are not likely to be so palatable as the supernumerary dishes I wish to abolish. But let it be remembered,

remembered, that I now address myself to the valetudinarian, whose better health I wish to promote, and which, with proper attention to himself, he may probably secure.

The gay and healthy voluptuary, is not the immediate object of medical document. I refer him, therefore, to that moralist, who was not less distinguished for his attempts to reform the manners of mankind, than for his refined taste, modesty, and moderation. His words are, “ For my part, when I behold a fashionable table set out in all its magnificence, I fancy that I see gout and dropsies, fevers and lethargies, with other innumerable distempers, lying in ambuscade among the dishes.”\*

Next to temperance, EXERCISE seems to have been designed, by the all-wise author of nature, as the great preserver and restorer of health, cheerfulness, and bodily strength. He who long neglects to embrace the advantages it offers, becomes in time, enervated, indolent, and dispirited; his appetite fails; the digestive faculties are impaired; the powers of muscular motion become gradually weakened; groundless apprehensions and anxieties seize upon the mind; fear be-  
comes

\* SPECTATOR, N<sup>o</sup> 195.

comes superior to the pleasures of recreation ; the tender debilitated individual shivers at the cool breeze ; till at length, his intellectual and corporeal faculties being overcome, he sinks, loaded with mental infelicities, into a state of torpid inactivity, and general relaxation.

But though exercise is so necessary to our healthful and pleasurable existence, it ought in every case to be proportioned to the patient's strength, and should never be continued so long as to bring on fatigue. The modes of it may be varied to suit his convenience or taste ; but should always if possible be performed in the open air, and either on an empty stomach, or some hours after eating. Though if the meal has been sparing and simple, gentle exercise employed almost immediately after it, will not in general be attended with any great inconvenience. That exercise is the most salutary which is moderate and long continued. All sudden and violent exertions can only be transient, and are often more hurtful than beneficial to an invalid.

Harrogate water is frequently used as a *warm bath*, and with great propriety, as it is a highly medicated one. The particular cases in which it seems to be applicable will be mentioned  
I hereafter,

hereafter. It may not however be improper to suggest, that the patient who has been advised to bathe, if he consults cleanliness and safety, should bring along with him from home a large flannel shirt, or gown, which he ought, as soon as he comes out of the bath and has been rubbed dry, to put on, and repair in it immediately to his own room, and if directed to sweat, to *his own bed* first properly warmed. This shirt is to be kept on till the sweat is over; it should then be washed and thoroughly dried, in the intervals between the times of using it, that it may be freed from sweat and perspirable matter.

The length of time the patient ought to remain in the bath, as well as the degree of heat necessary to be employed, must be varied according to the nature of the disease, and the patient's strength.

Harrogate is also well accommodated with a *cold bath*, which in many instances will be found extremely useful, especially to those who may have occasion to drink the *chalybeate* waters.

## P A R T IV.

## OF THE DISEASES IN WHICH HARROGATE WATER HAS BEEN FOUND USEFUL.

**W**E shall now endeavour to enumerate the diseases which have been either totally removed, or greatly relieved by the use of this water. And it is our design farther to recommend it in cases of a similar nature, in which there is a probability that it may afford relief.

For the sake of convenience to the reader, the diseases are placed alphabetically, without any regard to methodical nosology, which could serve no useful purposes in an essay of this kind. The leading symptoms of each disease are also specified, and some directions given in respect to drinking the water, diet, and exercise.

1. APOPLEXY. Under this title, the predisposition to apoplexy, and the means of prevention only, are meant to be considered: for when the

disease is actually present, very different measures from those we have now in view are required; though it is to be lamented they seldom prove successful.

Our views, therefore, should be principally directed to the prevention of the disease in those who are predisposed to it from original conformation, regimen, or habit of body.

The signs of a predisposition to apoplexy in the outward appearance of the body are, a large head, short neck, corpulency, a plethoric constitution, and for the most part, a red turgid countenance\*. When a person of this form and complexion has led a life of indolence and inactivity, has gratified himself in a full diet and frequent intoxication, and is advanced in years, he becomes still more subject to attacks of this disease, and more especially if he be of a costive habit†.

When apoplexy does not prove suddenly fatal, it is sometimes preceded by a swimming in the head, giddiness, head-ach, numbness in the extremities, drowsiness, false vision, tinnitus aurium, a more than usual fulness in the face and neck, incoherence

\* Vide Aphorism. Boerhaav. sect. 1010.

† Cullen's Lectures.

incoherence of speech, and frequent returns of incubus \*. A hemorrhage from the nose, particularly in the decline of life, and where the person has not been accustomed to it before, is often a certain prelude to the disease.

From a view of the several symptoms preceding an apoplectic paroxysm it would appear, that a plethoric habit and an over-distension of the blood vessels of the head in particular, are to be reckoned among the most frequent causes that produce it. There is, therefore, a probability that a long and steady course of low diet, consisting chiefly of milk and mild farinaceous vegetables, persevered in from an early period of life, a daily care to keep the bowels open by some gentle laxative, and an attention to the use of constant exercise, might prove an effectual security against this dangerous disease †.

Among these precautions, none is more necessary to be had constantly in view than that of keeping the body open ; since it is a measure particularly well adapted to relieve the plethoric state of the blood vessels of the head. It should not however, be carried so far as brisk purging, unless the patient complain of unusual fulness, or head-ach.

I 3

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\* Aphor. Boerh. sect. 1020.

† Cullen's Lectures.

As a remedy suited in every respect to this intention, I can safely recommend Harrogate water, provided the quantity be limited to two or three glasses; which if found insufficient may be quickened by a few Rochelle salts. These will raise no commotion in the system, and the danger of too great a fulness in the stomach will be avoided. This course may be regularly pursued during the summer months, by people of fortune whose situations in life will allow them to make an annual visit to Harrogate; but in winter, and to such as the expence of living there might prove an objection, I would advise the use of a mild gentle laxative at home; such as lenitive electary, castor oil, or Rochelle salts.

Patients of this class ought never to go into the *warm* bath; the rarefaction it occasions has been known to excite in the full and plethoric a fit of apoplexy immediately after they have left the bath. Cold bathing, though not liable to the same objection, may yet be hazardous, and therefore had better be avoided.

DIET. Particular circumspection with regard to diet is of great importance in the present case. It was a remark of the late Dr. Fothergill, that apoplectic fits were generally preceded by a full meal,

meal, or some excess in fermented liquors. Animal food should always be avoided at supper, and even at dinner the quantity ought to be moderate. There is no security without an observance of this rule. As substitutes for more gross aliment, tea, cocoa, milk, light broths and puddings, gruels, fruit-pies, potatoes, greens, and other mild vegetables, or the summer fruits, may be safely allowed, and perhaps a small quantity of animal food at dinner; provided it be cooked in a plain manner, and all heating sauces and spices avoided. Coarse bread with a little rye in it is preferable, on account of its laxative effects, to fine wheaten bread. Toast and water, imperial, lemonade, or *small* beer may be drank at meals. It is not, however, meant to be understood that those who have been long accustomed to a full diet, and are advanced in years, should abstain suddenly from the use of animal food and fermented liquors, but that they should retrench them gradually.

Having had several opportunities of observing that a giddiness of the head is apt to be excited by the improper use of tobacco, I have great reason to fear that any excess of it, in the present case, would prove particularly hurtful; and on that account it would be better if it were discontinued altogether. If this should be thought a hardship

to any, let me recommend as a substitute the use of the *calamus aromaticus*, or sweet scented flag, which possesses none of the narcotic qualities of tobacco, yet is equally powerful in promoting an excretion from the head, the sudden interruption of which, in those who have been long accustomed to it, might be attended with some hazard. Smoking tobacco, and taking snuff to excess, are equally pernicious.

EXERCISE. As persons predisposed to apoplexy are generally of a full habit, it is necessary for them to guard against this state of the body, not only by laxatives and low diet, but by exercise, which though it should never be violent ought to be long continued. The very corpulent will probably find riding on horseback, or perhaps in a carriage, sufficient for their strength. But those who feel no inconvenience from walking, or pursuing some other mode of bodily exercise, will reap more benefit from it than these we have just mentioned. Strong muscular exertions of every kind should at all times be avoided, as they heat the body, accelerate respiration, and predispose to apoplectic paroxysms. And it is by no means proper to employ exercise immediately after meals.

As

As exercise increases the appetite, it is absolutely necessary that the latter should not be too freely indulged, from a supposition that it has been compensated for by the preceding exercise. There is no state of the body in which an exact observance of these directions will be found more necessary than that which we are now considering.

Studious habits, especially if at the same time the head be kept in a depending position for several hours together, are unfavourable. It will also be a disadvantage to sleep in a heated room, or with the head placed low.

2. CHLOROSIS, or GREEN SICKNESS. This disease is marked by indigestion, costiveness, a desire to eat things improper for food, a pale bloated countenance, universal anasarca, debjection of spirits, listlessness, aversion to exercise, and a retention of the menses.

This complaint is confined to females, and attacks them only about the age of puberty. It arises from some defect in the organs of digestion and chylication, as is evident from the vitiated appetite and want of red blood in the system. There seems to be also a considerable degree of atony, or laxity, in the general habit.

When

When the disease is in this state, that relief may be obtained by a course of Harrogate waters, it will be adviseable for the patient to begin with the sulphureous water, and to finish the cure with the chalybeate. A glass or two of the former may be drank in the morning fasting for about a week, increasing or lessening the dose according to its effects, which should be limited to two or three motions daily ; for on account of the debility which prevails, it would be highly improper to reduce the strength by brisk purging. If the quantity here prescribed should prove insufficient, a pill or two of the *aloetic* kind may be taken over night. The cooling saline purgatives are less proper. When the stomach complaints are in some measure relieved, the sulphureous water may be discontinued, except occasionally when costiveness or any signs of a depraved appetite render a repetition of it necessary. Instead of it, half a pint of the chalybeate water from the *Tewit Well* may be drank in the morning fasting, an hour before dinner, and at five in the afternoon ; to which may be added from ten to fifteen drops of the tincture of iron prepared with spirit of salt. There are no remedies for this disease that we are yet acquainted with, which have been found equal to preparations of iron in restoring vigour to the constitution, and a healthful bloom to the complexion.

plexion. At the same time it will be of great advantage to go into the cold bath three or four times a week, either early in the morning, or if the patient be very delicate, an hour or two after breakfast; observing to make the immersions as sudden as possible, that the bracing effects of the bath may be obtained.

This course should be persevered in for at least a month or six weeks, in which time a keen appetite is generally acquired, the countenance becomes chearful and animated, and the body regains in a great measure its original strength and vigour.

**DIET.** The diet in this disease should be of the warmer stimulating kind, and consist chiefly of animal food well seasoned with spices, mustard, horse-radish, or cresses. A glass or two of generous port wine may also be drank at meals with real advantage.

**EXERCISE.** Of all the species of exercise, walking briskly for an hour or two after each glass of the chalybeate water will be found the most beneficial, as it determines the circulation more particularly to the lower extremities. When the patient is not in the use of exercise, let her carefully  
avoid

avoid exposing herself to the cold air. The feet and lower limbs should be kept warm; and it would be of service if they were to be rubbed gently, for an hour or two, every day, with a flesh-brush.

3. COLIC. The symptoms of this disease are too well known to admit description. The different species of it are distinguished by the causes producing them, and are named *bilious*, *flatulent*, *inflammatory*, &c. The two first are only to be noticed here.

(a.) *Bilious colic*. This complaint, besides the pain which is inseparable from it, is generally attended with frequent vomiting of bile. Those are particularly subject to it who are of a costive habit, who live well, and lead a sedentary life.

The remedies are sufficiently obvious, viz. gentle laxatives, sparing diet, and regular exercise. As a laxative, Harrogate water seems here to claim a pre-eminence over most others; and I have known instances where it has fully removed the complaint, when other means have proved merely palliative. It was drank in moderate quantities, and brisk purging was always avoided. Yet, should the bowels at any time be more  
costive

costive than usual, it may be proper to quicken the effects of the water by the addition of a few salts; and if the pain and spasmodic constriction be considerable, great relief would be obtained by going into the warm bath.

**DIET.** The diet, in this case, should be moderate in quantity, and rather of the cooling acescent kind, such as fruit-pies, farinaceous gruels, milk-whey, summer fruits, thin broths, fallads, and greens. What animal food is used at dinner (for it would be very improper at supper) should be of the white mild kind; and all oily and parched parts, baked and fried meats, ought to be carefully avoided. Common whey, cream of tartar whey, barley water acidulated with juice of lemons, toast and water mixed with a small proportion of Lisbon wine, imperial, or lemonade, may be employed as beverage. Red port and spirits are improper.

**EXERCISE.** The patient should render exercise habitual by appropriating to it a certain number of hours every day. Of all others, riding on horseback is the most eligible, because it promotes a quicker circulation in the region of the liver, and has a tendency to remove the obstructions which are often formed there.

(b.)

(b.) *Flatulent Colic.* This complaint frequently arises from indigestion, repletion, or food indigestible in its nature, such as nuts of all kinds when not sufficiently masticated, cucumbers, melons, and sometimes from too liberal an use of acid fruits, especially cherries and apples after meals. To prevent the attacks of this disease it will be necessary to avoid the causes which excite it; and as the bowels are generally costive, they should be kept open by some habitual laxative, such as Harrogate water, the dose of which is easily ascertained, and its operation remarkably gentle and easy. If it requires any assistance, two or three of Rufus's pills may be taken over night, or a spoonful of castor oil.

**DIET.** All flatulent food should be either totally abstained from, or used with the utmost caution. Animal food tolerably well seasoned, and the warmer vegetables are here allowable at dinner; and broths, gruels, or light farinaceous roots will furnish a safe and sufficient repast at supper. Toast and water with a very *small* proportion of old mild rum, geneva, or Madeira, are found to be the best diluents.

**EXERCISE.** Riding on horseback is particularly favourable to weak bowels, when it does not occasion

sion costiveness; if therefore it be constantly found to produce that effect, walking exercise should be substituted. A state of indolence impedes the proper action of the stomach and bowels, and unfits them for discharging their contents in a regular manner.

4. COSTIVENESS. This state of the body is closely allied to the preceding one, and the means of relief are nearly the same.

Harrogate water appears, from the testimony of many hundreds, to be a safe and effectual laxative, and as an habitual one has great advantages, because it acts with little or no stimulus. It may be taken with this view either at the wells, or at the patient's own house, as its *purgative* qualities are not much injured by keeping a *short* time.

5. DROPSY. It is only to those of a tolerably robust habit, and in cases where the disease is the consequence of a suppression of perspiration, or of urine, that I would recommend Harrogate waters as remedies. Dr. Bacher, a physician of eminence at Paris has found that the liberal use of watery liquids may be allowed with real advantage in many dropical cases; and I have repeatedly seen their good effects under certain limitations,

mitations, But whenever liquids are allowed in considerable quantities, attention should always be paid to the effects they produce. If the evacuations they procure exceed in quantity the liquids taken in, great advantages are then to be expected from them. With strict attention to this, I have known some relieved by drinking Harrogate water in such doses as have purged pretty briskly, and which have been repeated two or three times a week. But I have generally advised half an ounce of cream of tartar in powder to be mixed with the first glass; and on the days free from purging, the patient was desired to drink a glass of the chalybeate water in the morning fasting, another an hour before dinner, and another at five in the afternoon, with a tea-spoonful of sweet spirit of nitre in each, which has generally caused the water to operate powerfully as a diuretic. This promiscuous use of the sulphureous and chalybeate waters, with the medicinal additions before mentioned, may be continued for three weeks or a month, provided the hydroptic symptoms decrease; but if this should not be the case, the plan had better be laid aside after a short trial. In general, however, if there are no scirrhoties, or visceral obstructions, and if the original stamina are strong and robust, considerable benefit will probably accrue from a steady prosecution of the foregoing plan.

DIET.

**DIET.** After the dropfical fymptoms are removed, a dry diet, and bracing medicines, fuch as bark and fteel, will be ferviceable in confirming the cure. Milk is an excellent reftorative, and may alfo be ufed liberally during the cure, as there are inftances where it has proved an effectual remedy for this difeafe when no other means were employed.\* Animal food and a chearful glafs of port are not only allowable but neceffary to preferve the patient from a relapfe ; yet all the avenues which lead to excefs fhould be ftrictly guarded, fince every degree of ebriety might increafe that relaxation which a generous temperance would probably cure.

**EXERCISE.** Nothing tends more than bodily exercife to brace a debilitated habit, when judiciously employed ; but it fhould never be continued fo long as to bring on fatigue. Exercife either in a carriage, or on horfeback, may be tried firft, and as the dropfical fymptoms decrease, the patient fhould attempt walking exercife, which will not only expedite his cure, but probably confirm it. The flefh-brufh will alfo have its advantages, provided the frictions be gentle, long continued, and in the direction from the extremities towards the centre of the

K body.

\* Vide Med. Journ. vol. III. for 1782.

body. They promote the absorption and circulation of the lymph in the valvular lymphatics, and thereby carry off the extravasated water from the limbs.

Before I conclude what I have to say on this disease, I could wish it to be understood that no patient labouring under dropfical indisposition, whose viscera are unsound, and whose body is greatly emaciated and reduced, can expect relief from the waters at Harrogate, and therefore should not give them a trial.

6. ELEPHANTIASIS. The first symptom of this disease which appears is a swelling of the calf of one or of both the legs, which soon grows considerable and the part almost insensible to the touch, the finger leaves no impression upon it as it does on œdematous swellings, the cuticle which covers the tumor becomes scaly, and scirrhus tubercles about the size of nuts are formed upon it, but there does not appear to be any particular discoloration. After some time the face is disfigured with wrinkles, which are thick set with small tumors; the voice becomes hoarse, the throat ulcerated, the breath fetid, and the whole countenance acquires a livid hue. At last, the scirrhus tubercles both on the legs and face sup-  
purate

purate and degenerate into ulcers, which furnish an ill-conditioned pus of an ash colour, ferous and fetid. There is here a great analogy in the state of the fluids to that of the scurvy, and the symptoms are aggravated by mercury, as is always the case in that disease.

The elephantiasis seldom admits of a permanent cure, but may be greatly palliated by a simple bland moist diet, consisting chiefly of fresh vegetables, milk, emulsions, whey, broths, and gruels. Plentiful dilution by antiseptic fluids, especially by such as are apt to pass off by the emunctories of the skin and kidneys, affords considerable relief.

To answer this intention Harrogate water may be taken as an alterative, to the quantity of a pint three times a day, at the interval of four hours between every two glasses. As a detergent, and with a view of promoting perspiration more effectually, a warm bath of the same water may be employed twice or thrice a week; the patient may remain in it from five to fifteen minutes, and when he leaves it, it will be prudent for him to retire wrapped in flannel to his own room, and there to walk briskly for an hour or two, till he finds himself in a gentle sweat. He should then allow himself to cool gradually, and it would be

safer if he were to keep his room for the remainder of the evening. As an auxiliary, the peruvian bark, in doses of a drachm, may be taken in a glass of the Tewit-Well water three or four times a day.

Brisk purging is prejudicial in this disease, and therefore the water should be drank in moderate quantities. On the other hand, costiveness should be attentively guarded against.

DIET. There is no necessity to add much on this head to what has been already advanced, except that animal food should be very sparingly used; particularly the smoke-dried, or salted meats. Small beer, wine and water, cyder, perry, and imperial will afford the best beverage.

EXERCISE. No mode of exercise except that of a carriage, or riding on horseback, can with any degree of convenience be admitted of in this disease.

7. ERUPTIONS CUTANEOUS. We here propose to make a few remarks on that species of eruptive disorder called HERPES, and under that general title to include the *tetter*, *ring-worm*, &c. as varieties only of the same disease requiring a similar mode of treatment.

A HER-

AN HERPES is an eruption of the skin in appearance like a rash, consisting of small, red, itchy pimples, which when scratched discharge a thin watery serum, and in that state very much resemble the true itch. The eruption frequently spreads over the whole body, though in general it is confined to the inside of the arms, wrists, and lower extremities. It returns periodically in the spring and autumn, disappears in summer, and for the most part in winter. When long neglected, or improperly treated, it sometimes gives rise to troublesome ulcerations. Few diseases have been less understood by medical practitioners, than those of the eruptive kind. Few authors have been sufficiently descriptive of them, much less satisfactory in assigning their cause. And the generality of persons unacquainted with the science of medicine have confounded herpetic diseases with those of the scorbutic kind; but no two disorders are more opposite. Herpes generally attacks the young and plethoric, who in other respects enjoy high health, and is in its nature an inflammatory disease; the scurvy shews every indication of a putrid one: and when it is not brought on by putrescent diet, or long abstinence from fresh vegetables, is for the most part confined to the weak debilitated valetudinarian, who has passed the meridian of life in habits of rigid abstemiousness.

The constitution, we believe, has much less concern in herpetic cases than is generally imagined; the disease seems to depend more on local circumstances, and particular changes in the state of the atmosphere. This opinion we shall endeavour to explain in the following manner. The pores of the cuticle are extremely numerous, and it is easy to prove by direct experiment, that they far exceed in number the extremities of the exhalent vessels, which open immediately under the cuticle. From this it follows, that perspiration and sweat are poured out, *not* on the *surface* of the cuticle, but *under* it, and from thence ooze out, to use a familiar example, as through a sieve. In cold weather then there is reason to suppose that perspiration is not only diminished, as has been proved by statical experiments, but that the quantity of saline matter which ought to pass off by the skin is not evacuated in due proportion\*, and may therefore accumulate under the cuticle, where it may prove so stimulant and acrid as to cause an itching, redness, and perhaps some degree

\* That the saline matter of our fluids may, from certain circumstances in the animal œconomy, be sometimes preternaturally detained, is obvious from what happens in diabetes, hysteria, &c. where the urine is often voided perfectly inodorous, colourless, and insipid. From analogy therefore we may reasonably conclude that the same deficiency may occur in the cuticular discharges, which so nearly resemble, and are so closely connected with, the secretions of the kidneys.

gree of inflammation. The quantity, however, of this saline matter may not be sufficient to elevate the cuticle, till by some sudden alteration in the state of the air, as from that of extreme cold to a warm temperature, the perspirable matter be suddenly carried to the surface, where not being able to escape in the same proportion in which it is determined thither, because of the unusual quantity of saline matter already deposited, it immediately raises up the cuticle in the form of pimples or eruptions \*.

This method of reasoning will account for the prevalence of the disease in the spring, and during the vicissitudes of the weather in the autumn ; and for its absence during the summer and winter months, when the air is either constantly mild and warm, or cold and severe. Along with these circumstances it is probable there may be also, in some constitutions, an eruptive diathesis or

K 4

disposition

\* Perspirable matter being thus detained under the cuticle, will account for the small portions of the latter which are often forced off from the true skin, in the form of bran and scales, in many eruptive cases. There are also instances where both the cuticle and nails have fallen off in some diseases. We know that maceration will detach these, and that there is something analogous in their structure, since the rete mucosum spreads itself under the nails as well as under the cuticle ; they may therefore both be liable to the same effusion and desquamation,

disposition in the animal œconomy to favour the production of pimples on the skin, but which diathesis is liable to be easily influenced by a change of the seasons. For this reason we observe, that persons subject to herpetic eruptions are sometimes affected by them even in the winter, particularly if the weather has been extremely cold for several weeks together, and is suddenly followed by a great fall of snow, which has always a considerable effect in diminishing the intenseness of cold in the atmosphere.

When this disease is once established, it is apt to appear and recede periodically with the seasons, and does not readily admit of a radical cure. The indication however is to support as uniform a determination of the perspirable matter to the skin as possible; yet this ought never to be done by hot stimulating diaphoretics, as these never fail to aggravate the disease. It is much safer and more effectual to employ *warm bathing*, particularly in saline and sulphureous waters such as those at Harrogate; which not only cleanse the skin, and thereby promote the more equable evacuation of perspirable matter through its pores, but relieve the itching, heal the ulcerations, and leave the skin, after some time, smooth and in its natural state.

In

In many cases, however, the inveteracy of the complaint requires the internal use of Harrogate water at the same time; which has in several instances removed the complaint, and greatly relieved those who have tried it at my request. The water was advised to be taken as a gentle purgative twice or three times a week, and on the intermediate days as an alterative. A warm bath of the same water was also recommended to be used every second or third evening, according as the patients were able to bear it. This course ought to be continued for several months if the complaint should not yield sooner. And in very obstinate cases the cure may be greatly expedited by the use of this electary \* along with the waters, the size of a nutmeg of which may be taken *every* night, and two or three glasses of the water drank *every other* morning only. The bath to be employed as before. This electary I have frequently prescribed in private practice, and in the Infirmary at Leeds with great advantage, especially where it has been assisted by the occasional interposition of a cooling purgative. It is probable that antimonials are no otherwise useful  
in

\* Recipe, Conf. rosar. rub. unciam unam.

Crem. tartar. pulv.

Antimon. crud. lævig. ā drach. tres

Gum. Guaic. pulv. sesquidrachmam

Syr. rosar. solut. q. s. fiat electarium.

in many of these complaints, than as they promote perspiration: for as it has been before observed, the true herpes seems to depend more on a particular state of the skin, and on the sudden changes in the atmosphere, than on any peculiar acrimony in the fluids. And as antimony is found to promote perspiration more uniformly than most other remedies, it has deservedly gained the pre-eminence in all cases of the herpetic kind.

Herpes very frequently occurs in persons of plethoric habits, hale constitutions, and who enjoy good health. In all such cases Harrogate water should be taken as a brisk purgative, and its operation quickened by a few Glauber's salts. It is by this means rendered far superior to sea water, which sometimes proves too stimulating and heating; effects which Harrogate water is never known to produce when properly applied.

DIET. Along with the remedies above prescribed, it would be of the greatest service if the patient were to favour the general intention of promoting perspiration, by drinking plentifully of such warm diluents as contain little or no stimulus, such are common milk-whey, barley water, and weak saffrafrs tea. The solid part of his food should consist chiefly of vegetables, and  
a small

a small quantity of fresh animal food at dinner only. Salted meats are highly improper, and should be carefully avoided.

EXERCISE. This should be moderate but as constant as possible, that the perspiration may neither be too much increased by the excess, nor diminished through the want of it.

The mode of treatment here recommended will apply to cases of *tetter*, *ringworm*, and *tinea capitis*. In the latter, however, it will be necessary that the head be shaved every other day, and kept clean by washing it night and morning with the sulphureous water ; immediately after which a little of this ointment \* may be diligently rubbed into the sores, and the head secured from cold with a flannel cap.

8. Gout. This disease is too well known to require a particular definition. We shall likewise avoid entering into its history, peculiar nature, or proximate cause ; as these would lead us into a wide field of discussion very foreign to an essay of this sort. What we have chiefly in view is, to  
caution

\* Recipe, Ung. e pice unciam unam cum semisse.

—— cærul. mit.

Petrol. Barbad. ā drach. tres. fiat. ung.

caution arthritic persons against the improper use of Harrogate water in some states of this singular disease. Many have fallen into an error in this respect, by attending to the representations of individuals who have been benefited by drinking the water; and who have recommended it to others from a supposition that their cases were similar, when in fact they have been essentially different. In our attempts to relieve the gout, two cases of it are to be carefully distinguished.

1. \* Where the constitution is sound and vigorous, where the fits are severe and regular, and where there is a plethora and inflammatory diathesis.

2. When the constitution is debilitated and diseased; the fits irregular; the alimentary canal, head, breast, and urinary passages, affected with various complaints alternating with fits of the gout.

In the first case † it will afford the patient great relief in the intervals of the fits, to prevent plethora and an inflammatory disposition of the body by cool regimen; either a total milk and vegetable diet, or the most moderate use of fermented liquors

\* Vide GREGORY'S ELEMENTS, p. 196. † Idem.

liquors and animal food plainly dressed ; by gentle evacuations, particularly by stool ; by exercise, especially walking, frictions, and even in some cases where the predisposition is very strong, by bodily labour ; by an easy cheerful mind, and regular hours in regard to sleep.

In the second case \* the indications during the intervals are, to support the *vis vitæ* or natural vigour by the moderate use of animal food and wine. To promote an equal distribution of the blood to the extremities, and to keep up perspiration by exercise, frictions, temperate bathing, warm bathing, and warm pumping, especially when the joints become stiff ; warm clothing, and keeping the legs and feet warm. To obviate debility, indigestion, and acidity in the stomach, by avoiding the causes of these ; by the cautious use of bitters and aromatics, lime-water, alkalies, Bath and Buxton waters, and stomach laxatives.

From the foregoing description of two opposite cases of the gout it will appear, that Harrogate water can only be employed with advantage in the former of them ; and even then it ought to be  
drank

\* Vide GREGORY'S ELEMENTS, p. 197.

drank rather as an habitual laxative than a brisk purgative; because whenever a fit of the gout is brought on by causes which debilitate the vital and animal functions, the patient generally suffers for it in his future health. But there will be still a greater impropriety, and the consequences will be more lastingly serious, if this water be used liberally as a purgative in the 2d. case, or that species of gout called the *atonic*, where the natural vigour is on the decline, and the powers of nature inadequate to the production of regular, inflammatory paroxysms.

I am acquainted with one instance in which an elderly gentleman had been long in the habit of paying an annual visit to Harrogate, and who in his younger years had experienced great benefit from drinking the waters, as they seldom failed to relieve his plethoric symptoms. But as his general health declined in more advanced age, he was still improperly solicitous of repeating his visits to Harrogate, contrary to the strenuous remonstrances and advice of his physician who recommended to him a course of the Bath or Buxton waters, as his fits of gout had been for some time irregular and imperfect. His resolutions however were formed, and he posted away to Harrogate. The consequences were, that he  
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fell into a state of great debility at his return ; in a short time became dropfical, and from that period never experienced one regular gouty paroxysm, though nature seemed to make many ineffectual efforts towards it. The conclusion may be easily deduced ; he lingered on, labouring under an endless variety of anomalous complaints, for many months, during which he tried both Bath and Buxton without success, and at last died universally anasarcaous.

Harrogate water, therefore, can only be drank with impunity in the 1st. case. But it may probably be used as a *warm bath* in the 2d. case with advantage, if the patient be careful to remain but a short time in the bath, and have it heated rather higher than usual, by which means its stimulant effects may be obtained, and its relaxing powers in a great measure prevented.

DIET. To enter minutely into this subject as some late writers have done, would lead us too far from our present intention. We think it sufficient in general to remark, that in the 1st. case before mentioned the diet should be sparing, light, and easy ; and consist chiefly of milk, vegetables, and a small quantity of animal food at dinner. Fermented liquors should be taken with great caution.

In the 2d. case the diet may be more warm and stimulating, and the patient may be indulged in the more liberal use of wine, provided he never exceeds the bounds of temperance.

**EXERCISE.** The young, the hale, and the plethoric, in whom the fits of gout are regular and inflammatory, will be greatly benefited by the use of much bodily exercise. The aged, the infirm, and the emaciated, in whom the paroxysms are imperfect and return at longer intervals, must content themselves with riding on horseback, or in a carriage, and endeavour to keep their extremities warm by additional clothing, cork soles, and the daily use of the flesh-brush.

9. **HEADACH.** When the headach proceeds from indigestion, acidities in the stomach, or a costive state of the intestines, and is not attended with fever, it may be effectually relieved by Harrogate water taken as an habitual laxative; and in plethoric constitutions, as a purgative.

**DIET.** In a complaint of this nature, the diet should always be sparing, light of digestion, and such as is not apt to turn acid on the stomach.

**EXERCISE.**

**EXERCISE.** Gentle easy exercise in the open air will be of considerable service, but should never be used immediately after meals, as it is then apt to excite head-ach in those who are predisposed to it.

**10. HYPOCHONDRIAC AFFECTION.** This complaint is generally marked by great languor, torpor, irresolution, timidity, dejection of spirits, and a constant apprehension of danger from the slightest causes. The stomach is also sometimes affected with dyspepsia or symptoms of indigestion, such as loss of appetite, flatulency, heart-burn, pain in the lower belly, and costiveness. The disease is generally confined to persons of dark fallow complexions and melancholic temperaments, in whom there is a rigidity of the solids, a dry system, and spare habit; yet the veins appear to be full and turgid, as the balance of the blood is thrown more especially upon them, and thereby produces a degree of venous plethora.

Let us take up the indications of cure in this disease on what grounds we please, no method we can employ will perhaps afford the patient more relief, than that which places him in a situation where medicine, amusements, and company, jointly contribute to remove the symptoms of indi-

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gestion,

gestion, relax the too great rigidity of the system, elevate the spirits, recreate the mind and dispose it to think favourably of its own feelings. In order to obtain these advantages at Harrogate, the patient should drink the water in *moderate* doses, to each of which he may add a drachm or two of soluble tartar, a salt which possesses superior advantages over all the other neutrals in hypochondriacal disorders. One of the properties of Harrogate water is, that it exhilarates the spirits during its operation, which renders it singularly serviceable in this disease, where the mind is often gloomy, and magnifies its own distresses through the medium of misapprehension, or false fear.

Cold bathing, on account of the rigidity of the system which prevails, is here improper; but great benefit has frequently been received from the use of the *warm* bath; and as the relaxing effects of the bath are desirable, care must be taken that the water be not too much heated; if it be perceptibly warm to the touch it will be sufficient. The patient may remain in it from a quarter to half an hour, and repeat the bathing two or three times a week. He should be careful to guard against cold when he leaves the bath; but as sweating is not required, there

is no necessity for him to go to bed before his usual hour.

A middle aged gentlewoman of a dark fallow complexion and melancholic temperament, but who did not complain of any of the symptoms of dyspepsia, had laboured under this complaint for a considerable time, and had taken a variety of medicines by the direction of her physician without benefit. Among other remedies she tried the cold bath, which increased her disorder. Her friends grew uneasy and requested that I would visit her. As she was averse to medicines, I desired her to make a trial of the plan just recommended, and in three weeks or a month she returned in perfect health and spirits.

DIET. As there is an uncommon torpor both of the mind and body in this disease, every cause that increases this disposition is to be avoided, such as full living, intoxication, narcotics of every kind, especially the liberal use of spirits, tobacco, coffee, and tea; though with regard to the two latter some distinction is necessary: for when the hypochondriac affection is unaccompanied with indigestion, and is chiefly marked by a melancholic disposition, coffee and tea may probably be allowed with advantage, as they produce a

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degree

degree of relaxation in the system not unfavourable to patients of this class, in whom a too great rigidity of the solids prevails. To this purpose an eminent physician remarks, that the drinking tea and coffee is always hurtful to the dyspeptic, but is commonly very useful to the hypochondriac \*. Yet it is adviseable that every one should consider the effects of tea upon his constitution when in health, before he attempt to employ it as a remedy in disease. And it requires no small share of dispassionate sagacity to fix the limits of good and harm in the present case. Multitudes of all ages, constitutions, and complexions, drink it freely, during a long life, without perceiving any ill effects. Others, again, soon experience many inconveniences from drinking any considerable quantity of this infusion †.

The same distinction is to be made respecting other articles of diet. When acidity, heart-burn, and flatulency prevail, acrescent food of every kind, as well as coffee and tea, should be avoided, and plain roasted or boiled meats preferred. On the contrary, a light easy vegetable diet will best suit the truly hypochondriacal, provided the symptoms of indigestion are wanting, but in both cases  
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\* CULLEN's First Lines, vol. iii. p. 134.

† See Observations on Tea, by Dr. LETTSOM, p. 38.

every degree of excess, either in eating or drinking, should be guarded against. Toast and water will perhaps afford the least exceptionable beverage, as it is free from the narcotic effects of spirits and fermented liquors, which, whether the case be dyspeptic or hypochondriacal, are always pernicious.

EXERCISE. That species of exercise which amuses and excites the attention, is to be preferred to mere mechanical exertions where the mind has no share. Nothing is more hurtful to hypochondriacs than absolute idleness, or a vacancy from all earnest pursuit. It is owing to wealth admitting of indolence, and leading to the pursuit of transitory and unsatisfying amusements, that the present times exhibit to us so many instances of hypochondriacal disorders \*. That exercise therefore which is pursued with ardor, which requires address and dexterity, or which engages the person in a degree of anxiety, such as hunting, shooting, driving a phaeton, or riding on horseback, is the best adapted to patients of this sort. Exercise in an easy carriage, in the direction of which the traveller takes no part, unless it be upon rough roads, or driven pretty briskly and with long continuance, is of little advantage †.

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II. ITCH.

\* CULLEN's First Lines, vol. iii. p. 137. † Idem. p. 144.

11. **ITCH.** The itch, though arising from a cause very different from that which produces herpes, may be safely and readily removed by the same means that have been directed for the cure of the latter ; with this difference, that the antimonial is in the present case unnecessary.

12. **JAUNDICE.** This disease is too well known to require a definition. The principal symptoms are, a preternatural yellowness of the white part of the eye ; a dusky red colour in the urine ; white fæces ; and in general, a considerable degree of costiveness. The disease arises from an obstruction in the duct which, in a healthful state of the body, conveys the bile from the gall-bladder into the intestines ; and the most frequent causes of it are biliary calculi or gall-stones ; viscid bile ; or a spasmodic constriction of the duct itself.

But though we were acquainted with a solvent for the two first of these when out of the body, it would be impossible to apply it directly to them when they are situated in the gall-duct in such proportions as would always render it effectual. The only indications therefore which we have in our power are, to promote the passage of the gall-stones or viscid bile through the duct ;  
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and to relax the spasm when that happens to be the cause of the disease. These may be attempted by vomiting, purging, and by the use of the warm bath. Vomiting, in this case, acts to advantage by compressing the gall-bladder and duct, which may probably force their contents forward into the intestines. It may also operate by emulging the biliary duct; since any irritation in the stomach and intestines is readily communicated to this duct.

As another means of soliciting the action of the biliary duct, and of removing costiveness, we may employ purgatives, which, in common with every other stimulus applied to the intestines, have a power of exciting or of increasing the action of the various excretory ducts that open into them. All drastic purgatives, however, or such as act with violence and produce considerable irritation are improper. For as the disease is generally of long duration, it requires the frequent repetition of laxatives, which should therefore be *mild*, that the constitution may not be injured by them. Of this kind is Harrogate water, which in proper doses operates briskly without causing any pernicious irritation, and consequently may be repeated every other morning, or as often as costiveness and other symptoms seem to make it

necessary. To the first glass may be added a few drachms of soluble tartar, which will not only increase the purgative effects of the water, but will render it in some degree saponaceous, and it will thereby more nearly resemble the bile, which in a healthful state affords a natural stimulus to the bowels.

My ingenious friend CHARLES WHITE, Esq; of Manchester,\* supposes that the jaundice may sometimes arise from a stoppage of the mouth of the bile-duct by tenacious gluten obstructing, either totally, or in part, the passage of the bile into the duodenum. The best cure for this he has found to be *raw eggs* taken frequently in cold water; and very rationally concludes that they act by dissolving the gluten at the mouth of the duct.

The *warm bath* may likewise be found of considerable service by relaxing the duct, and thereby allowing the biliary concretions to pass; and by taking off the spasmodic constriction in the duct when that happens to be the cause of the disease. The patient may go into the bath three or four times a week, and remain in it about half an hour each time, if his strength be able to bear it.

DIET.

\* See his excellent treatise on the management of pregnant and lying-in women, p. 76. & seq.

**DIET.** It is not necessary that the patient should deviate from his usual course of diet, provided he be careful to avoid every degree of excess both in eating and drinking. I wish however to recommend, upon the authority before mentioned, the trial of a fresh raw egg mixed with a glass of spring water as a part of the patient's diet, which he may take every four or five hours.

**EXERCISE.** As the symptoms which attend the jaundice are always greatly increased, and in some cases brought on by a sedentary life, it will be absolutely necessary to employ regular exercise every day; and of all others riding on horseback is the most salutary: next to this, the exercise of a carriage upon rough uneven roads; as both these have a tendency to remove the obstructions which are the cause of the disease, and to prevent them from forming in future.

13. **LEPROSY.** This disease is distinguished by an uncommon roughness of the skin, upon which white furfuraceous eschars appear that are sometimes humid and itchy, at other times dry and scaly. The disease first makes its appearance on the surface of the skin in the form of small red spots, which are generally of a roundish figure,  
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rising a little above the level of the skin, yet they are *not pointed*, but *flat* on the *top*. The cuticle which covers them becomes thinner by degrees, and at last separates in a transparent scale. A fresh cuticle is soon generated, which likewise falls off and is succeeded by another as before. The eruption sometimes spreads over the whole body ; at other times it is more confined. It disappears spontaneously in summer, returns again in winter, and seldom admits of a permanent cure. There is reason to believe that the disease is topical, because it yields more slowly, and with less certainty to internal remedies than to warm bathing, and other external applications ; though when these are jointly employed, greater advantages are generally obtained from them than from either of them singly.

A course of mineral waters and the use of the warm bath, or of sea water and sea-bathing, have at all times been prescribed as the most effectual means of relieving this disease. Harrogate water has been found particularly useful when taken internally as an alterative, and applied externally as a warm bath. It is at least equal, if not superior, to sea water in the cure of this obstinate complaint, and may be drank from half a pint to near a pint on an empty stomach three times a day,

day, at intervals of four or five hours. This will prevent it from passing off too quickly by the intestines, and allow a considerable quantity of it to be absorbed into the mass of blood; from which it may be again discharged along with the perspirable matter, and by that means produce some favourable effects upon the leprous eruption. That a sulphureous matter frequently passes off from the body along with the perspiration, when Harrogate water has been drank as an alterative, we have this convincing evidence, viz. that it sometimes discolours silver coin in the pockets.

14. PILES. One of the principal symptoms of this disease, and which alone frequently produces it, is costiveness. Though on the contrary it may arise from a very opposite cause, namely brisk purging, especially when that is brought on by *aloetics*, and such purgatives as strongly stimulate the rectum. Local affections in or near the anus, and a sedentary life, are also liable to excite the disease in those who are predisposed to it. But from whatever cause the complaint takes its rise, it is for the most part greatly aggravated by costiveness, and when that is removed, the disease is generally cured, or greatly relieved. The propriety of employing *very gentle* laxatives is obvious, because there is a necessity of repeating them

them frequently, and because the acrid stimulating purgatives increase the complaint. Among the milder laxatives, sulphur and its preparations have always been found the most beneficial in this disease, and none of them more so than Harrogate water, which operates so gently, that where circumstances will admit of its being constantly employed it merits a preference to every other remedy I am acquainted with. I could adduce several cases in support of this opinion; but, that I may not intrude too much on the reader's time, shall only offer the following.

An elderly gentlewoman who had long been afflicted with the piles applying to me for advice, informed me that she had tried a great variety of cooling laxatives, and even sulphur in all its forms, but they all gave her pain, and produced a considerable degree of irritation in her bowels, particularly in the *intestinum rectum*. I recommended to her a trial of Harrogate water, and was not disappointed in my expectations. At her return she told me that the water had agreed perfectly well with her; that it had neither caused gripings nor uneasiness during its operation; that it had been effectual in removing the costiveness to which she was liable; and had entirely relieved her complaint.

DIET.

DIET. When the disease we are considering happens to a person of a full plethoric habit, who uses little exercise, and in whom the tumors in the anus are subject to bleed, a sparing moist diet which contains nothing stimulating or heating will be necessary. Intemperance in the use of fermented liquors should be carefully avoided. Coarse bread with a small proportion of rye in it will be useful, on account of its laxative effects.

EXERCISE. Costiveness is one of the most frequent causes of the piles, and is very often brought on by a sedentary life. It will, therefore, be of great consequence to the patient to guard against it by exercise, particularly by walking, as riding on horseback is, in this disease, less proper.

15. RHEUMATISM. There are two kinds of rheumatism, the *acute* and *chronic*. The first of these is accompanied with fever, and an inflammatory disposition in the system, and therefore cannot properly be noticed here. The chronic rheumatism, under which title we also mean to include the SCIATICA, is unattended with fever; the pained joints are without redness, are cold and stiff, cannot easily be made to sweat; for while a free  
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and warm sweat is brought out on the rest of the body, it is clammy and cold on the pained joints \*.

What relief is to be expected from Harrogate water is chiefly to be obtained by employing it as a warm bath, three or four times a week; and while the patient remains in it, the pained parts should be gently rubbed, that the circulation in them may be rendered more free and equal. It will also be of use to support a natural warmth in the parts where the pains are seated, by covering them with soft dry flannel. The bowels should be kept regularly open by the internal use of the water, which may, at the same time, afford some advantages by the antispasmodic effects it produces on the system in general.

**DIET.** The patient has no occasion to be particularly circumspect in his diet, provided he be careful to keep within the limits of moderation and temperance.

**EXERCISE.** It is of some consequence to take care that the pained or stiff joints are properly exercised, either by moderate friction when the patient is in the bath, or with the flesh-brush when

\* CULLEN's First Lines, vol. i. p. 335.

when he comes out of it. And that he may obtain more than a temporary benefit by this mode of exercising the part, the friction should be gentle, but continued at least an hour each time. The application of electricity in sparks, or moderate shocks, may likewise be useful to the parts affected. Blisters also commonly afford very great relief. Walking exercise, if it can be born without much inconvenience, should not be neglected ; but if it increases the pain considerably, riding on horseback had better be substituted for it.

16. SCROPHULA. There are two cases of this disease ; first, where the glands are only enlarged and indurated : secondly, where they have suppurated and formed ulcers. In both these cases saline waters are found to be the best remedies when assisted by the cold bath, proper diet, and regular exercise.

Scrophula is a *constitutional* disease, in which not only a degree of debility prevails, but in which there is also a peculiar acrimony in the fluids of the body. Although the disease is *hereditary*, it does not appear to be *contagious* ; because scrophulous children live in common with those in perfect health, yet the latter were never known to receive any infection from the former.

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The indications of cure are two-fold,

1. To obviate the debility and want of tension in the system.

2. To carry off the acrimony which is present in the fluids.

The first indication is answered by the long continued use of the *cold bath*, which has advantages, as a tonic, over sea bathing, because the former is considerably colder. One immersion at a time will be sufficient; but it ought to be made as *suddenly* as possible, and repeated every other morning. As an auxiliary to the cold bath, and with a view of supporting the tone of the system more effectually, a drachm of powdered peruvian bark may be taken three or four times a day, along with ten or fifteen drops of the acid elixir of vitriol, in a tea-cupful of the chalybeate water of the Tewit-Well.

2. Plentiful dilution by some saline water has at all times been recommended as the best means of carrying off acrimony from the system; since it is capable, from its great fluidity, of entering into the minutest vessels of the body, and of promoting all the various excretions. Sea water has been particularly celebrated in this case, on account of the saline matter which it contains, and  
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certainly deserves many of the encomiums which have been bestowed upon it ; yet it is often liable to pass off too quickly by the intestines, when it is drank in sufficient quantity to render it useful as a diluent. We must therefore in general, either mix it with a proper proportion of common water, or otherwise have recourse to some mineral water which naturally contains such a quantity of sea salt as makes it efficacious as a stimulant upon the excretory vessels, but which does not cause it to pass off too suddenly by the intestines.

Of this sort is Harrogate water, when it is taken in doses as large as can possibly be admitted of without purging. And to prevent this effect in some very delicate and irritable habits, a quarter of a pint, or a little more, of the chalybeate water may be mixed with every pint of the sulphureous water. This will rather improve its diluting qualities, without injuring its stimulating effects upon the different excretories of the system. A glass or two of the waters, mixed in this proportion, may be drank three or four times every day upon an empty stomach, at intervals of about four hours. If they should still continue to produce purgative effects, let them be mixed in equal quantities, that the bowels may be enabled to

bear nearly three pints a day, in divided doses, without their procuring more than one or two motions.

In all cases of scrophula, it is necessary for the patient to persevere in drinking the waters for a considerable length of time; because the ulcers are generally slow in healing. Yet it may not be improper to intermit the use of them for a week or two, every six weeks or two months, lest the strength of the patient should be too much reduced.

DIET. The diet in these cases should be of the bland mild kind. All salted meats, cheese, dried fish, and other aliments which contain a particular acrimony, ought to be avoided. Yet, on account of the debility which prevails in the general system, plain animal food may be allowed with advantage at dinner; and a glass or two of generous port may be drank after it. Milk will probably afford the most suitable nourishment at breakfast and supper. Common whey, barley water, or toast and water, may be drank liberally, and are useful diluents. A pint or two of the fresh juice, or of the strong decoction of coltsfoot leaves, drank in divided doses every day, has been greatly celebrated in cases of open ulcer.

EXERCISE.

EXERCISE. Riding on horseback is to be preferred to all other modes of exercise, in scrophulous cases.

17. STOMACH COMPLAINTS. Various are the disorders to which the organs of digestion are liable, either from a natural debility or defect in the constitution, or from improper diet and regimen. Among these we may enumerate loss of appetite, nausea, vomiting, over distension, frequent eructations, heartburn, spasmodic pains, and constipation of the intestines. These symptoms very often proceed from debility in the fibres of the stomach, which may have been brought on by the frequent use of tea, coffee, opium, inebriating liquors, tobacco, snuff, or large meals which cause over-distension not only by their bulk but by the extrication of a large quantity of air during the process of digestion, which is generally slow in morbid affections of the stomach. Costiveness, grief, disappointment, depression of spirits, and the frequent use of emetics, are also very common causes of these complaints.

When the patient is acquainted with the causes which excite or increase his disorder, he ought to avoid them with the utmost caution ; and endea-

vour to promote the proper action of the stomach by such means as, at the same time that they relieve the symptoms, have a tendency to remove the costiveness which never fails to aggravate his distress. A remedy possessed of these virtues we find in Harrogate water, which by correcting and carrying off the contents of the stomach and bowels, removes the inflation, nausea, sickness, and heart-burn. The coldness of the water acts powerfully as a tonic, not only on the stomach itself, but on the whole system, provided its purgative effects are limited. For although it may be of great consequence to prevent costiveness, it will be highly improper to reduce the patient's strength by brisk purging. On this account, the Harrogate water should be drank in moderate doses, or such as procure an easy motion or two every day, and no more. If two or three glasses should not be sufficient for this purpose, a Rufus's pill or two may be taken over night to quicken their operation; since over-distension, from too large a quantity, would be highly injurious.

As another means of restoring the tone of the stomach, and of assisting the digestive faculties, ten or twenty drops of the acid elixir of vitriol may be taken in a quarter of a pint of the chalybeate water, an hour before dinner, and an hour  
before

before supper. This generally restores the appetite, and removes the eructations, heartburn, and sickness. If the spasmodic pain in the stomach be considerable, I would recommend to the patient to mix a glass of the sulphureous water with an equal quantity of spring water boiling hot, and to drink it immediately. In stomach complaints, the *cold bath*, by the additional strength it gives to the constitution, has uncommonly good effects, and may be employed two or three times a week, either early in the morning, or if the patient be very delicate, about eleven o'clock in the forenoon.

DIET. Great caution is necessary in regard to diet. Every degree of excess is to be strictly guarded against; and the quality of the food is also to be considered. That kind of diet which has a tendency to become acid upon the stomach is to be avoided, such as fruits, greens, tea, coffee, gruels and stups of every kind. A moderate quantity of plain animal food, shell-fish, and well fermented bread, will be the most proper at dinner; and may also be eaten, but in smaller quantities, at supper.

The beverage which is the least exceptionable, and which possesses a restraining and bracing  
M 3 property,

property, is toast and water mixed with a little brandy. But the quantity of the spirit employed should always be carefully ascertained; and in general a table spoonful will be found fully sufficient for half a pint of water, when the mixture is designed for common drink. It should always be a rule with dyspeptic patients never to trust to the eye in determining the quantity of spirits they drink. Many through a want of this necessary care, have gradually increased the proportion of spirit, till incurable evils have been the consequence.

EXERCISE. Early rising, and exercise on horse-back when the stomach is empty, have singular advantages in all cases of dyspepsia or indigestion; and there is hardly any disease in which they are more necessary.

18. STONE AND GRAVEL. This complaint is generally attended with nausea, vomiting, numbness of the thigh, pain in the loins, and a frequent inclination to make water, which the patient is seldom able to do except in very small quantities. After brisk exercise the urine is often bloody. In this disease Harrogate water has been found useful, not only by relieving the costiveness, which adding to the pressure upon the kidneys and ureters

ureters increases the complaint, but by promoting a greater secretion of urine, and by diluting it so that it becomes incapable of forming calculous concretions. To make the water subservient to this purpose it should be drank for a considerable length of time, and in such quantities as operate very gently by stool.

A gentleman of my acquaintance received more benefit from Harrogate water in a calculous complaint, than from any other means he had employed, though he had tried a variety of lixivia, both caustic and mild. It was his annual custom to spend two or three months every summer, at Harrogate; and to drink the water in moderate doses, both as an alterative, and as a gentle laxative. During that time he generally passed several small stones, and a considerable quantity of gravel. If, during the passage of any of these, the pain was considerable, he commonly went into the warm bath, from which he found great relief. At his return home, he seldom complained of any inconvenience for many months afterwards.

DIET. In all calculous diseases the diet should be light and sparing; and it is probable that the use of a considerable quantity of honey in the

patient's tea, or other beverage, may afford him great relief. This has been strongly recommended by Sir John Pringle, and I know one instance of a gentleman in the neighbourhood of Leeds, in which it has had excellent effects.

**EXERCISE.** The patient should employ some mode of exercise, but it ought to be gentle; perhaps that of a carriage upon smooth roads, or walking, may be the most safe and salutary.

**19. ULCERS.** There are numerous instances which prove that Harrogate water has been of singular service in many ill-conditioned ulcers, when it has been taken as a gentle purgative every other morning, and as an alterative on the days between. The ulcers have been kept clean by washing them with the same water twice a day; and dressing them with some mild digestive, such as the yellow basilicon mixed with a small proportion of the red precipitate. After the ulcers are healed, it is of the utmost consequence to the patient, especially if the ulcer has subsisted for several years and the discharge from it has been considerable, that this redundant matter should be carried off, or compensated for, by an issue, or repeated doses of some mild purgative taken at the interval of four or five days; and for this purpose,

purpose, Harrogate water is perhaps to be preferred to most others,

20. WORMS. The symptoms commonly assigned as the criteria of worms are, an itching of the nose; acid eructations; a depraved, or otherwise a voracious appetite; a pale mournful countenance; a hard swelled abdomen; a swelling of the upper lip; and in some cases a grinding of the teeth during sleep. The only certain sign, however, is that of passing the worms along with the fæces.

There are several kinds of worms that infest the intestines, as the *tape-worm*; the *round worm*; and the *ascarides*: the last of these generally confine themselves to the rectum. Harrogate water has been found an excellent remedy in worm cases, but especially against the round worm and the ascarides, when it has been taken as a brisk purgative. The ascarides being seated within the reach of this water when it is injected as a glyster, that mode of applying it has been found singularly useful, along with proper doses of it drank as a purgative. When Harrogate water is applied by the anus, half a pint of it may be made boiling hot, and, in that state, be added to near a pint of it cold, which will be a proper quantity for one glyster, to be injected every other day.

Five or six grains of levigated calomel may be taken twice a week, at bedtime, in a little currant jelly, and be purged off in the morning, by three or four glasses of the water. This course may be continued for three weeks or a month, but the calomel should not be persevered in much longer, lest the mouth be affected by it.

**DIET and EXERCISE.** It is not necessary to be very particular in respect to these, provided the patient does not indulge himself in habits of intemperance, or of indolence.

It is not our present design to enlarge the foregoing list of diseases; though it is probable there may be some others, in which Harrogate water might be usefully administered; but we are not sufficiently well acquainted with facts, to recommend it with the same confidence we have done in those already enumerated. And as no person ought imprudently to enter upon a course of any mineral water before he has consulted his physician, we desire to leave it to the discretion and judgment of those who are intrusted with the patient's health, either to recommend or discourage the use of the medicinal waters we have been considering, as the nature of the patient's case, his former habits, or the component principles of the waters seem to indicate.

Harrogate

Harrogate water appears to be improper in all febrile and inflammatory diseases; in diabetes; consumption; hectic fever; asthma; atonic gout; agues; excess of the menses; and other diseases in which a state of relaxation and debility in the muscular fibres prevails.

21. I have purposely omitted to mention the SCURVY among the diseases against which Harrogate water has been recommended; because, as it is a putrid disease attended with great prostration of strength and commonly arises from putrescent diet at sea, it does not appear that Harrogate water can be administered but as a doubtful remedy at best. I am aware that it will be objected, that many persons labouring under the true scurvy have received great advantages from the use of Harrogate water. I do not attempt to deny this, yet may venture to assert that the water can seldom be applied when it is most wanted, viz. to those persons who, having just arrived from a long voyage at some of the sea ports, are at such a distance from Harrogate, that it would be much easier for them to seek a remedy in a course of fresh vegetables upon the spot, than to undertake a long journey, in hopes of meeting with a cure from Harrogate water.

As

As to the LAND-SCURVY it is a rare disease, and happens only to persons who are particularly situated. “ It hath been asserted, that men living on shore will be affected by the scurvy, though they have never been confined to salted meats; but of this I have known no instance, except in those who breathed a marshy air, or what was otherwise putrid; and who wanted exercise, fruits, and the common herbs. Under such circumstances, it must be owned, that the humours will corrupt in the same manner, though not in the same degree, with those of seamen.”\*

In such cases, a healthy dry situation, proper diet and exercise, and the moderate use of some antiseptic mineral water like that at Harrogate, would undoubtedly procure relief.

\* Sir JOHN PRINGLE's Discourse on preserving the health of seamen.

A N  
E S S A Y  
ON THE  
WATERS of THORP-ARCH.

---

Disce, docendus adhuc quæ censet amicus : ut si  
Cæcus iter monstrare velit : tamen aspice, si quid  
Et nos, quod cures proprium fecisse, loquamur.

HORAT.

Hic gelidi Fontes, hic mollia prata, Lycori,  
Hic Nemus —————

VIRGIL.

---



## P A R T V.

## OF THORP-ARCH WATER.

1. *Of the situation, soil, &c.*

**T**HORP-ARCH is situated near the great road leading from Tadcaster to Wetherby, at the distance of four miles from the former, and three from the latter; and about twelve or thirteen miles from York and Leeds. The river *Wharfe* runs on the south of the village with a swift and rapid current. Its banks, though they cannot boast of those ornaments which distinguish the grand or the sublime, are yet pleasingly diversified with natural columns and rocks of limestone; which form, in a curious and sportive manner, irregular wooded hollows and bare projections, delightful by their variety, and beautiful through their contrast. The river, its limpid and swift stream, craggy precipices, commodious bridge, and cascade at the mill, are charmingly picturesque,

picturesque, and constitute the primary ornaments of the village. The seat and pleasure grounds of Wilmer Gossip, Esq; at a little distance, add greatly to the beauty of this scene.

The fish, with which the Wharfe abounds, are remarkably fine; particularly the salmon, which acquires an uncommonly fine *goût* from the peculiar sweetness, rapidity and clearness of the water.

The sloping disposition of the valley towards the south, and the briskly agitated stream, serve the useful purposes of ventilation, and render the air grateful and healthy; though as it sweeps over a tract of dry upland country for many miles, where there are neither swamps nor marshy grounds to injure its salubrity, it may be supposed that it has not much occasion for this assistance. Indeed the uncommon purity of the air of this place is such, that many have experienced its good effects, who have scarcely tasted its medicinal waters. As a proof that the inhabitants of this village are remarkably healthy, I shall subjoin a short extract from a letter addressed to the late Dr. Short \* by a gentleman of veracity in the neighbourhood, who writes as follows; “ In the sixteen years that I have been acquainted with the neighbourhood,

\* Vide. SHORT on Mineral Waters, 8vo. p. 56.

Neighbourhood, it has had no epidemical disorders of any kind, except the small-pox, measles, and colds. It has been remarked by the inhabitants, that servants hired from other places into this village, after they have been here a month or two, have had a fresher, healthier, and clearer complexion, than when they first came." He farther remarks, that the births greatly exceed the burials, and that there are, upon an average, five of the former to each marriage. He produces several instances of longevity, though the number of families in the whole village did not, at that time, exceed forty or fifty.

The soil consists chiefly of sand and clay mixed with limestone gravel. The rocks which form the banks of the river are of the calcareous kind. The country is fruitful in corn, and affords a great variety of flowering shrubs, and medical plants. There are no mines, either of coal or metals, in the neighbourhood; yet it is not destitute of minerals, as appears by the medicinal water which is the immediate object of our investigation; by a well of chalybeate water formerly existing there, but which has been lately filled up by the order of the owner; and by a strong sulphureous spring, situated about two or three miles south west of the village.

The roads are in general good in this country ; and there is an extensive piece of open ground on *Bramham-Moor* adjoining to Sir John Goodricke's park ; and another near the village of *Clifford*, where the turf is remarkably fine, and the prospects delightful : both of these are very convenient for morning exercises, either in carriages, or on horseback.

The mineral water at Thorp-Arch was accidentally discovered on the 4th of June, 1744, by John Shires, an inhabitant of the village, who, to the credit of this watering place, has been in the habit of drinking the water very frequently, from the time it was first known to the present, viz. 1784. He is now in perfect health and spirits, and seems to enjoy a particular satisfaction at the growing reputation of this valuable spring.

The pump by which the water is raised stands on the south, or Clifford side, of the river, between that and the foot of a high perpendicular rock of limestone. It is placed so near the river that in high floods it is overflowed, and the river water mixes with that of the spring. At other times they seem to have no communication.

There are in this village two excellent Inns conveniently situated ; but the resort of people of  
all

all ranks has of late years been so great that they are hardly sufficient to contain the company; though the improvements which are now making will render the place far more commodious and agreeable.

2. *Of the sensible qualities of Thorp-Arch water.*

The water when taken fresh from the pump has a limpid sparkling appearance, saline taste, and a *slight* sulphureous smell. When it is exposed to the air it becomes rather turbid, and the smell goes off. It curdles soap. On the surface of the water which rises into a basin between the pump and the river, and which communicates with the pump-water, a thin film may be discovered which reflects the coloured rays. At the bottom and on the sides of this basin, and also in the channels through which the water runs from the pump to the river, a brown ferruginous sediment is deposited.

The water is possessed of purgative and diuretic virtues; but it is remarkable that a long course of dry weather lessens the quantity of saline matter which it contains, and its strength is thereby greatly impaired. After heavy rains, or a small influx from the river, the water is always found

to operate more powerfully, and passes off more readily by all the emunctories. This may perhaps be accounted for by supposing that the saline stratum, by which the water is impregnated, is so situated that the rain water either descends through it in its passage to the pump, or raises the spring so high as to reach it, by which means a larger portion of the salt is dissolved and mixed with the water.

With regard to the *temperature* of the water, a good Fahrenheit's thermometer, which stood at 60 degrees in the open air, when immersed in a large pail full of the water taken fresh from the pump, fell immediately to  $47^{\circ}\frac{1}{2}$ . The river water raised it to  $53^{\circ}$ . This experiment was made on the 26th of May 1783, when the weather was serene and temperate.

### 3. *Experiments and remarks on Thorp-Arch Water.*

In the month of June 1783, I made the following experiments upon this water taken fresh from the pump. I drank a glass of the water containing about eight ounces, in the morning fasting; at that time my pulse beat 84 strokes in a minute; in five minutes afterwards 80; in ten minutes 76; in fifteen minutes 76; in twenty minutes

minutes 76; in thirty minutes 80; in forty minutes 84, per minute. I walked very gently both before and after I had drank the water.

REMARKS. From this trial it appears that the water has a sedative effect upon the circulation, a property which may render it applicable in cases where the motion of the fluids is preternaturally increased. But whether this effect is to be ascribed to the degree of cold which the water communicates to the system, or to its mineral impregnations, we do not attempt to determine. It is probable, however, that considerable advantages may be obtained from it when the water is drank at proper intervals.

In conducting the following experiments we shall pursue the same order that we have done before in the analysis of Harrogate water. And as the causes which produce the various changes, when different substances are mixed with mineral waters, have been already explained, it will be unnecessary to repeat them. The reader is therefore desired to refer to the remarks which follow each experiment in Part III. page 85 & seq.

It has already been observed that Thorp-Arch water has a *slight* smell of sulphur; that when it

is exposed some time to the open air it is covered with a thin film which reflects the coloured rays ; and that it deposites a reddish brown sediment in the channels where it runs.

REMARKS. The preceding circumstances lead us to suppose that the water contains a small quantity of *inflammable air*, and that it is generated from iron, because the matter which rises to the top, and likewise that which is deposited on the sides and bottom of the basin near the pump, is clearly a reddish brown ochre, calx, or earth of iron. When water is once impregnated in this manner, it will continue to yield this scum or film for a considerable time after the air has made its escape \*. Iron may also be suspended in water by fixed air which when it is exposed to the atmosphere escapes, and the iron is deposited in the form of ochre.

### EXPERIMENT I.

A few drops of lime water were mixed with a glass of the Thorp-Arch water taken fresh from the pump ; a slight milkiness was immediately produced, and a small portion of a whitish precipitate

\* See Dr. Priestley on Inflammable Air, PHILOSOPHICAL TRANS. vol. lx.

pitae was deposited on the sides and at the bottom of the glass. The sides of the glass were also thick set with air bubbles, which continued to adhere for at least twenty-four hours.

REMARKS. The result of this experiment and the sparkling appearance of the water clearly demonstrate the presence of *fixed air*, which is fully confirmed by the subsequent experiment.

## EXPERIMENT II.

The tincture of litmase, which is of a purple colour, was immediately changed by this water into a bright red, but which the mixture lost when it had been exposed for a few hours to the open air, and after twenty-four hours there was no perceptible difference between this mixture and one made of the infusion of litmase and distilled water. A little ley of tartar was mixed with a glass of the water, but it caused no effervescence.

REMARKS. This experiment was made with a view of discovering the *vitriolic acid*, but as the change produced by the infusion of litmase was transient, we may rather ascribe it to the fixed air than to this acid in a separate state, especially

as the sensible qualities of the water, and the change produced by lime water seem fully to confirm this opinion; and as no effervescence was raised by the ley of tartar.

### EXPERIMENT III.

A few drops of the solution of lead in the nitrous acid not fully saturated were mixed with a glass of the water; no immediate change succeeded, and only a very small portion of a greyish sediment was deposited after the mixture had stood for twenty-four hours.

REMARKS. There is no reason to conclude from this experiment that the water contains any vitriolic acid in a *combined state*, because the change was but just perceptible after the mixture had stood for many hours.

### EXPERIMENT IV.

A little fresh syrup of violets was mixed with a glass of the water, but little or no change was produced by it.

REMARKS. This experiment was made to ascertain the presence of an *alkali*, but as the mixture

ture did not assume a green colour we may conclude that the water contains not the smallest portion of this salt. It also proves that the quantity of fixed air is not very considerable, because it did not change the syrup to a red colour. The infusion of litmase is a much nicer test of the presence of fixed air than the syrup of violets, and the result of Exp. II. clearly evinces it. I obtained a salt by evaporating a large quantity of this water, a portion of which I dissolved in distilled water and then added to it a few drops of the syrup of violets, but it caused no change, nor did it effervesce with the vitriolic acid.

If the salt had effervesced with the vitriolic acid and had been dissolved by it, the nature of the alkali, whether fossil or vegetable, might have been easily known by evaporating the mixture, and observing the figure of the crystals. Pure alkalies, of whatever kind they are, do not form crystals of any sort, but solutions of them leave on evaporation a dry white mass which ferments strongly with all the acids.

#### EXPERIMENT V.

A few drops of the solution of corrosive sublimate were mixed with a glass of the water, but they

they caused no perceptible difference in its appearance.

REMARKS. This experiment was made with a view of discovering the nature of the alkali, if any had been present in the water, which however from this and the preceding experiment does not appear to be the case.

#### EXPERIMENT VI.

A salt was obtained by evaporating a large quantity of the water, which did not afford rectangular prismatic crystals like those of Epsom salt, nor did the precipitate which was obtained by mixing a fixed alkali with a quantity of this water dissolve in diluted vitriolic acid: from this it is evident that not the least portion of *Epsom salt* exists in the water.

#### EXPERIMENT VII.

The salt did not crystallize into hexagonal prisms terminated by a pyramid of the same number of sides, nor did it detonate with charcoal.

REMARK. It is clear by this experiment that the water is not impregnated with *nitre*.

Ex-

## EXPERIMENT VIII.

A gallon of the water was evaporated in the heat of a water-bath, from which near an ounce of salt was obtained, the crystals of which were of a cubical figure, and united together into hollow truncated pyramids. When a little of this salt was placed on a hot iron it decrepitated strongly, and burned with a bluish flame. Another portion of this salt was dissolved in distilled water, to which were added a few drops of the solution of silver in the nitrous acid not quite saturated, the mixture immediately became turbid, and a white precipitate was formed resembling a *luna cornea*, which was insoluble in distilled water.

REMARK. All these trials plainly prove the salt to be of the *muriatic kind*.

## EXPERIMENT IX.

Quicklime was added to the residuum obtained by evaporation and the mixture subjected to a considerable degree of heat: no change was produced.

REMARK. If the residuum had contained an *ammoniacal salt*, a volatile pungent smell would have

have been perceived when quicklime was mixed with it, especially as heat was applied.

### EXPERIMENT X.

A small quantity of the saturated solution of lead in the nitrous acid was dropped into a glass of the water: at first very little change was observed, but when the mixture had stood twenty-four hours a very small proportion of a white precipitate was found at the bottom. From a gallon of the water evaporated in Experiment VIII. were obtained, besides the salt, sixteen grains of *earth*. A little of this residuum was mixed with diluted vitriolic acid with which it effervesced strongly but was not dissolved by it.

REMARKS. These experiments shew that the earth which enters into the composition of Thorp-Arch water is *calcareous*; but they do not preclude the possibility of its containing *selenites* also.

### EXPERIMENT XI.

A few drops of the ley of tartar were mixed with this water which immediately turned it milky, and caused a copious precipitation. This precipitate effervesced with diluted vitriolic acid. The water curdled soap.

REMARK.

REMARK. These experiments demonstrate the presence of *selenitical earth* in this water.

## EXPERIMENT XII.

The earthy residuum was not dissolved by diluted vitriolic acid, nor did it assume a red colour with the infusion of litmase.

REMARKS. Had the earth been of an *aluminous* nature it would have been dissolved by diluted vitriolic acid, and when mixed with distilled water would have imparted a red colour to the infusion of litmase; but as neither of these were observable, we may conclude that the water is not impregnated with alum. We are likewise certain that it does not contain magnesia, because the precipitate caused by the ley of tartar was not dissolved by the vitriolic acid.

## EXPERIMENT XIII.

A very slight milkiness was produced by mixing a little vitriolic acid with this water, but the small portion of precipitate which was by this means occasioned, did not change to a brown or black colour with the solution of saccharum saturni, nor was the sulphureous smell increased when

when the vitriolic acid was added to the water. The earthy residuum obtained by evaporation when thrown on a hot iron did not emit flame, nor smoke, but was gradually converted into a hard brown mass.

REMARKS. There is no reason to suppose that the water contains *sulphur per se*; the precipitate was not only inconsiderable; but the smell of sulphur was not increased when the vitriolic acid was added; nor did the residuum discover any signs of it when it was placed on a hot iron.

#### EXPERIMENT XIV.

A piece of paper was moistened with the solution of saccharum saturni in distilled water, which was then dried and placed over a glass of this mineral water, but it was not discoloured after remaining several hours.

REMARKS. Thorp-Arch water has only a very slight sulphureous smell; and as it produces no change with the solution of saccharum saturni, we may conclude that it is not impregnated with a sulphureous vapour, otherwise than by means of the solution of a small portion of pyrites in fixed air or the volatile vitriolic acid,

acid, which by producing inflammable air may impart this smell to the water.

#### EXPERIMENT XV.

This water imparted a faint purple colour to the infusion of galls, especially when a few drops of lime water were added ; these also caused a thin purple film to form on the top which reflected the coloured rays. After standing for a considerable time, the glass of water which contained the infusion of galls lost its purple hue, and that to which both lime water and galls had been added changed into a fine green.

REMARKS. It appears by this experiment that the water is slightly impregnated with *iron*, which is probably suspended in it by fixed air or the volatile vitriolic acid ; but it is more likely to be by the former, because the water shews every other mark which is known to distinguish the presence of that elastic fluid, it is sparkling to the eye, precipitates lime from lime-water, and converts the purple infusions of vegetables into a bright red.

#### EXPERIMENT XVI.

The caustic volatile alkali did not change the water to a blue colour.

REMARK.

REMARK. There is no reason to suppose that the water contains *copper*.

## EXPERIMENT XVII.

Neither the taste of the water, the figure of the crystals which were obtained by evaporation, nor the residuum, exhibit any of the common signs of the presence of *zinc*.

From the foregoing experiments it appears that Thorp-Arch water contains

1. Inflammable air;
2. Fixed air;
3. Muriatic salt, in the proportion of an ounce to a gallon;
4. Calcareous earth, and } together gr. xvi. in
5. Selenitical earth,     } a gallon;
6. A small portion of iron suspended by fixed air.

### 4. *General observations on the use of Thorp-Arch water.*

This water, like that at Harrogate, possesses purgative and diuretic virtues; but as the proportion of salt which it contains is considerably less than that in Harrogate water, it is necessary, in general,

general, that it be drank in larger doses. The principles which compose Thorp-Arch water give it a superiority over Harrogate water in general relaxation, bilious disorders, glandular obstructions and scirrhoties, stomach complaints, and spontaneous vomitings. Harrogate water is to be preferred in cutaneous diseases, the piles, rheumatism, worms, ulcers, and probably in the stone and gravel. In many other cases the medicinal virtues of the two waters appear to be nearly equal.

The doses of this water are to be varied according to their effects and the prescriber's views; and the same precautions we gave in regard to Harrogate water are as necessary to be attended to in the use of this. The water should never be drank in immoderate quantities at a time, lest it prove hurtful by causing over-distension in the stomach and bowels. When it is required to operate as a purgative, it may be taken from one glass containing seven or eight ounces to four or five, at the interval of twenty minutes or half an hour. If this quantity fail to produce the desired effect, it should not be increased, but a small quantity of Rochelle or Glauber's salts, of soluble tartar, or of rhubarb, according to the nature of the case, should be added to the first glass.

Or, if more agreeable to the patient, a little magnesia, rhubarb, lenitive electary, castor oil, or Rochelle salts may be taken over night.

Neither this nor any other mineral water should be drank when the body is too much heated; yet a proper degree of exercise ought always to accompany its use, as that greatly promotes its operation both by the intestines and by the kidneys.

THE MORNING is the best season for exercise, not only because the stomach is empty, but because we are then more alert and chearful, and better disposed to enjoy the pleasure of a ride, or the beauty of a prospect. Exercise soon after meals is sometimes apt to disturb digestion, and to cause painful sensations in the stomach and bowels, acid eructations, and heartburn. When these symptoms come on, they rob the individual of his chearfulness at a time when perhaps his recovery greatly depends on the constant tranquillity of his mind.

The same attention, with respect to temperance and regimen, that we have endeavoured to inculcate in our general remarks on the use of Harrogate water, is proper to be observed here. The  
patient

patient should chuse for himself plain wholesome food, avoid every degree of excess, and take his meals at regular hours ; for long fasting, and too frequent indulgence are both improper, since they injure the digestive faculties and generally bring on other disagreeable consequences.

There is proper convenience at the INNS, for employing the water as a warm bath. But it is rather to be regretted that no provision has yet been made for accommodating the company with a cold bath, though there are several very fine springs of fresh water in the village.

THE AIR at Thorp-Arch is so sweet and salubrious, the prospects so pleasing, and the walks so inviting and delightful, that there can be little doubt, if the water has been properly recommended, that the patient will receive every advantage that his heart can wish, both of health and of pleasure, from a visit to this charming village ; especially if he improve the advantages it offers by early rising, morning exercise, temperance, chearful company, light suppers, and early sleep.

5. *Of the Diseases in which Thorp-Arch Water is indicated.*

1. APPETITE WANT OF. This complaint frequently arises from a natural delicacy in the constitution, a relaxed state of the fibres of the stomach, costiveness, improper food, anxiety, grief, and a sedentary life.

Stomach complaints are generally aggravated by costiveness, which ought to be removed prior to the use of tonics or the cold bath. For this purpose Thorp-Arch water may be employed with great advantage; but ought to be taken rather as a gentle laxative than as a brisk purgative. If therefore two or three glasses drank in the morning fasting at the interval of twenty minutes should be found insufficient, the patient had better take a Rufus's pill or two over night than increase the dose of the water, lest it should prove hurtful by causing over-distension; nor should the water, even in these moderate quantities, be repeated oftener than two or three times a week. Along with this remedy, the *cold* bath prudently employed will afford considerable service, by giving additional tone to the general system, and thereby promoting the proper action of the stomach upon its contents. Twenty drops of the acid elixir of vitriol

vitriol may also be taken in a glass of spring water, or cold chamomile tea, an hour before dinner and supper.

As anxiety and all the depressing passions are hurtful to digestion, the patient should endeavour, by exerting a proper fortitude, to guard against every source of discontent as much as lies in his power. This he will be better able to accomplish by engaging in some of those exercises which not only require muscular action, but at the same time employ the attention, and divert the mind from dwelling improperly on any painful sensation. Riding on horseback, or in an open carriage where the patient takes the sole direction of it upon himself, shooting, bowling, &c. are perhaps the most proper. The morning air is cool bracing and salutary; we would therefore recommend early rising and morning exercise. It would likewise be of use if the patient were to ride or walk an hour before dinner and supper.

The diet which is found to sit light and easy on the stomach should be preferred. Smoke-dried and salted meats or fish, cheese, fat and oily parts of meat, should be avoided. Light suppers generally cause sound sleep, and give a keen appetite in the morning: the patient ought therefore

either to take his supper early in the evening and use exercise after it, or make it sparing and light. He should be careful to avoid every degree of excess in eating and drinking, because this not only hurts digestion but relaxes the system, and destroys the natural serenity of the mind; while abstemiousness and temperance are the great supporters of health and spirits, and the only sure means of preventing diseases.

2. CHLOROSIS. The remarks which have been made on this disease at page 121, will apply here, with this difference, that as there is no chalybeate water at Thorp-Arch the tincture of iron may be taken in spring water.

3. COLIC. What has been said on the *bilious* and *flatulent* colic at pages 124 and 126 will render a repetition of it unnecessary here. Thorp-Arch water may be employed in these diseases both as a purgative and as a warm bath, under the same restrictions that have been before recommended.

4. COSTIVENESS. This complaint may be very safely and effectually removed by the use of this water; but when it is designed merely to relieve an habitual costiveness it should be drank sparingly, or in such quantities as are only just sufficient to answer the intention.

Early

Early rising, and the use of exercise in the cool air before breakfast, with the daily habit of going every morning to stool without waiting for a natural call, will in time establish a custom of this sort, and a moderate quantity of the water will greatly assist in acquiring it.

5. ERUPTIONS CUTANEOUS. In these cases Harrogate water certainly claims a superiority over that at Thorp-Arch; yet the latter has been frequently employed with considerable benefit. The method of using it should be the same with that which has already been recommended in the use of Harrogate water at page 132; and there will be little occasion to add any thing to what has been there said respecting diet, exercise, and cleanliness. A frequent change of linen is of the greatest consequence in promoting the cuticular discharges, and should always be practised by those who are liable to cutaneous eruptions. The use of the cold or the warm bath, two or three times a week, is likewise almost indispensibly necessary. The eastern nations were, of all others, the most subject to cutaneous diseases, and to them cleanliness was of such importance that it was strictly enforced by mandatory law. The Jewish legislator, under the influence of theocracy, as well as the author of the Mahometan religion, both enjoined the frequent

use of purification and a peculiar delicacy in the choice of food. Swine's flesh was probably forbidden because it was thought to be the least perspirable of all others.

6. HEAD-ACH. When this complaint proceeds from a plethoric state of the system, costiveness, or a sedentary life, it is to be relieved by gentle purgatives, sparing diet, and moderate exercise. See page 144.

7. HYPOCHONDRIAC AFFECTION. Under this title at page 145, we have already taken notice of the symptoms, causes, and method of treatment, peculiar to the disease, to which we desire to refer the reader. Thorp-Arch water may, with propriety, be employed here, in the same manner as Harrogate water.

8. JAUNDICE. Thorp-Arch water has been found very efficacious in this disease. For a farther account of the complaint, method of drinking the water, regimen, &c. see page 150.

9. MESENTERIC GLANDS OBSTRUCTED. This disease is generally confined to children and young persons; the principal symptom of it is a hard swelled belly, owing to the enlarged size of the  
the

the mesenteric glands and sometimes to a tympany. The last is generally symptomatic, and may arise from a loss of tone in the intestines, or the extrication of a greater quantity of air from the chyle which is detained longer than usual in the bowels on account of the obstructed state of the glands of the mesentery. Sometimes the tympany does not occur, and then considerable inequalities may be perceived by the touch upon the abdomen externally. When the disease is slow in its progress there is no hectic disposition in the system. At other times a hectic fever accompanies the other symptoms, and is marked by evening flushings and night sweats; the disease then acquires the name of *Tabes mesenterica*. Along with these symptoms it is not unusual for the patient to void worms: this has led many into a wrong treatment of the complaint, as their attention has been very often solely confined to that circumstance.

For the most part the lymphatic glands of the neck are also swelled, and it is a common observation that the disease is frequently connected with *scrophula*. Physicians have generally looked upon this complaint as incurable, and indeed it is too frequently so; yet there are a few instances which seem to prove the contrary. We find that  
scrophulous

scrophulous tumors in other parts of the body are sometimes removed without advancing to suppuration; and is there any reason to suppose that those of the mesentery are of a more obstinate nature? The scrophula, it is true, is a very untractable disease, and does not speedily admit of a cure; but whether this be owing to the remedies commonly employed, or to the operations of nature, may be difficult to determine. It is a disease seldom cured in less than three or four years, in which time it is probable, if no medicines were given, that the ulcers might heal spontaneously. But allowing this to be the case, it is well known that the disorder admits of *some* relief from medicines, because the enlarged glands sometimes appear to diminish more speedily during the use of them.

Of all the remedies we are acquainted with none have been found so beneficial, or have been so universally recommended in cases of mesenteric obstruction, as *mineral waters*. Those impregnated with saline substances are preferable to all others; but it should always be a rule in prescribing them to avoid their purgative effects: they ought therefore to be taken in moderate quantities at a time, and be repeated two or three times a day, at considerable intervals. Thorp-  
Arch

Arch water is particularly well adapted to this complaint, as the quantity of saline matter it contains is not so considerable as to make it pass off too readily by the intestines, but allows it to be taken in sufficiently large doses to answer our views as an attenuant and deobstruent. A great error has been committed, and the advantages which might have been received have been frustrated, by drinking these waters in such quantities as have purged briskly : for when that is the case they do little more than wash out the alimentary canal, and are prevented from entering the lacteals in such proportion as would render them salutary.

**DIET.** A mild bland diet consisting chiefly of milk, whey, mild vegetables, and moderate quantities of animal food at dinner only, will be necessary.

**EXERCISE.** As indolence and inactivity have a great share in producing glandular obstructions, the patient should, upon the very first appearance of these complaints, allot certain hours in the day to riding on horseback, or to walking, which will probably prevent the disease from gaining ground, and might, perhaps, have obviated it altogether had it been properly attended to in due time.

10. PILES. The water at Thorp-Arch may be drank with great advantage in the piles ; though it is, perhaps, inferior to that at Harrogate in the cure of this painful disease. See page 155.

11. SCIRRHOUS LIVER. Those are most subject to this complaint who live well, and use little exercise. The circulation of the blood in the region of the liver is slow, on account of the peculiar anatomical structure of the parts, the liver being supplied with blood by means of a large vein. This serves an useful purpose in allowing time for the secretion of a proper quantity of bile, but at the same time lays the individual under the necessity of employing exercise to prevent obstructions from being formed. It has been observed that persons who indulge themselves freely in the use of fermented liquors, and especially of spirits, are particularly liable to liver complaints. A scirrhus liver is also sometimes the consequence of preceding inflammation, and remittent fever.

When the disease is once formed, let it arise from what cause it may, if it be not attended with fever or inflammatory symptoms, the cure may be attempted by the long continued use of some saline mineral water such as that at Thorp-Arch,  
in

in moderate doses, so regulated as not to move the bowels more than two or three times a day at most. And for this purpose three glasses, of eight ounces each, in a day, will in general be sufficient, viz. one in the morning fasting, one at four in the afternoon, and another at bed time; and along with each I would recommend a pill consisting of five grains of the extract of hemlock to be taken, which will greatly assist the deobstruent effects of the mineral water.

**DIET.** The patient's diet should consist chiefly of milk, mild vegetables, whey, and thin broths; and he should avoid animal food, fermented liquors, and particularly spirits.

Riding on horseback in the open air ought not to be neglected, since it is of the utmost consequence to avoid indolence, and there is no species of exercise which tends more to relieve visceral obstructions than this.

**12. SCROPHULA.** The symptoms and method of treating this complaint, with the peculiar advantages which are derived from a long course of mineral waters, have been before particularized at page 159, to which permit me to refer. Thorp-Arch water is remarkably well adapted to this disease, as the portion of salt it contains is just sufficient

sufficient to make it active as a gentle stimulus upon the excretories, without causing it to operate too powerfully by the intestines. The diet, exercise, and the use of the cold bath have been recommended before at pages 162, and 163.

13. STOMACH COMPLAINTS. See pages 163, and 196.

14. STONE AND GRAVEL.. In this disorder the water should be drank as a gentle purgative, and as an alterative. Its diluting effects will be found serviceable as it passes off very freely by the kidneys. And when it is taken as a gentle purgative, once or twice a week, it takes off any hurtful compression that might be made upon the kidneys and ureters by a large collection of fæces in the abdomen.

15. VOMITING SPONTANEOUS. In weak nervous habits, where the stomach is particularly irritable, and has probably been rendered so by too rigid an abstemiousness or improper regimen, Thorp-Arch water has been found singularly beneficial. The fixed air and the muriatic salt it contains, are probably the principles to which we ought to ascribe these advantages. The water in this case should never be taken in large quantities;

ties ; half a glass in a morning, another about an hour before dinner, and another at five in the afternoon will in general be sufficient, unless costiveness should render fuller doses of it necessary. From ten to twenty drops of the acid elixir of vitriol may be taken, on an empty stomach, in a glass of spring water twice a day.

The patient's DIET ought to be light and easy of digestion ; and the quantity should be moderate, for every degree of repletion will bring on the complaint.

MORNING EXERCISE in the open air, and the use of the cold bath two or three times a week, will be attended with very considerable advantages.

It is probable that many other ironical diseases might be added to those we have here enumerated ; but we leave it to time, facts, and farther experience, to point them out.

Before we conclude it will but be justice to observe, that it is probable many of the good effects which are commonly ascribed to a course of mineral waters may, in some measure, belong to other causes ; at least many other circumstances are certainly to be admitted as powerful auxiliaries ;  
such

such as a change of air from that of a populous town, perhaps, to the sweet salubrious air of the country, early rising and early sleep, a strict attention to regimen and the use of exercise, and probably above all, an agreeable exchange of the cares and anxieties of business, or of a family, for the salutary influences of that hilarity which is constantly excited by chearful company, a variety of objects, innocent amusements, and the rational pleasures of society.

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